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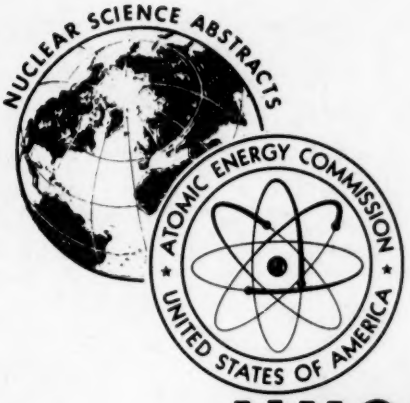

NUCLEAR SCIENCE ABSTRACTS

Volume 15 Number 1

Abstracts 1–1104

January 15, 1961

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NUCLEAR SCIENCE ABSTRACTS

Volume 15, Number 1

January 15, 1961

GENERAL AND MISCELLANEOUS

1 HW-63824

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

RADIOLOGICAL CHEMISTRY OPERATION SEMIANNUAL REPORT FOR JULY–DECEMBER 1959. J. M. Nielsen. Mar. 15, 1960. 68p. Contract AT(45-1)-1350. OTS.

Separate abstracts have been prepared on 10 sections of this report. A list is included of publications and papers during the period of time that is covered by this report. (C.H.)

2 ITR-1193

Radio Electronics and Television Manufacturers Assn., Washington, D. C. and Federal Civil Defense Administration, Battle Creek, Mich.

THE EFFECTS OF A NUCLEAR EXPLOSION ON COMMERCIAL COMMUNICATIONS EQUIPMENT. Preliminary Report. Raymond H. Williamson. May 1955. 60p. Project 35.2 [of] OPERATION TEAPOT. OTS.

Atomic-blast exposure tests on commercial communications equipment were conducted during Operation Teapot, Apple II shot. These tests were made to provide civil defense planners with data for qualitative predictions of the probable survival range, the extent of damage, and nature of repairs required to restore communication service after a blast. Approximately 150 widely diversified units of communications equipment (mainly electronic, but including sirens) were exposed, under the sponsorship of the Radio-Electronics-Television Manufacturers Association (RETMA), two siren manufacturers, and the Federal Civil Defense Administration (FCDA). Exposed items were in or near groups of structures located at approximately 4700 and 10,500 ft from ground zero. Where possible, identical products were exposed at these two locations, so that one set of items would be subjected to moderately severe damage and the other set to light damage. Tests showed that commercial communications equipment was generally more resistant to nuclear explosion damage than the structures in and near which the products were exposed. Additions concerning communications equipment were proposed to supplement FCDA published statements concerning "Blast Damage from Nuclear Weapons of Larger Sizes." (auth)

3 TID-3701

Office of Technical Information Extension, AEC.

INFORMAL LISTING OF BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Bibliographies Issued or in Progress During the Period August–September 1960. Informal Supplement Number 6 to TID-3043(Rev.1) (Suppl.1). 21p.

A bibliography containing 122 references is presented on reactor technology, radiation effects on materials, corrosion studies on reactor materials, particle interactions, radiation chemistry, and radiobiology studies. (C.J.G.)

4

DESIGN OF THE SECOND RADIATION LABORATORY AND RESULTS OF DOSE RATE MEASUREMENT. Yoshitada Tomoda, Motome Hamashima, and Masaaki Takehisa. Tokyo Kôgyô Shikensho Hôkoku 55, 250-9(1960) July. (In Japanese)

The first radiation laboratory was built about two years ago; its irradiator was installed with a 274-curie Co^{60} source, which has decayed to a present value of about 200 curies. In the new laboratory the irradiator has a Co^{60} source of about 2000 curies, but it can be used safely with a Co^{60} source up to 3000 curies. These two laboratories are used to study effects of radiation on organic reactions, such as polymerization of olefins under high pressure, chlorination, etc., and also the effects on catalysts and others. The fundamental calculating scheme for the design of the laboratory and irradiator is discussed. Results on the determination of the dose-rate distribution of gamma-rays in the laboratory under working condition are given. The radiation laboratory was designed on the basis of the following requirements: Permissible leak dose rate of gamma rays should not exceed 0.1 mr/hr in any place around the laboratory. A sample up to 100 mm in diameter and 200 mm in length should be able to be irradiated under dose rate of 10^5 r/hr. To measure the dose-rate distribution, Victoreen dosimeters (Radocon), chemical dosimeters (Fricke's solution), and photographic methods (photographic emulsion) were used. The dose rate was measured at 2.7×10^5 rad/hr in August 1959. (auth)

5

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, Eng.

UNITED KINGDOM ATOMIC ENERGY AUTHORITY SIXTH ANNUAL REPORT, FOR THE PERIOD, 1st APRIL, 1959–31st MARCH, 1960. 78p. $0.70.

The information presented in this volume covers production plants, reactor-development program, general research and development, controlled thermonuclear reactions, nuclear weapons, raw materials, health and safety, information services, commercial operations, and international relations. (W.L.H.)

BIOLOGY AND MEDICINE

General and Miscellaneous

6 HW-63824(p.22-4)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE RELATIONSHIP OF BIOASSAY MEASUREMENTS TO Zn^{65} BODY BURDENS. R. W. Perkins.

An evaluation was made of the reliability of data from bio-assay measurements as a means of estimating the Zn^{65} body burden in man. Data are tabulated on excretion of Zn^{65} at various times after ingestion by man. (C.H.)

7 LA-2420
Los Alamos Scientific Lab., N. Mex.
METABOLISM OF C^{14}-ISONIAZID IN HUMANS. Irene U. Boone, Arthur Murray, III, Roger Des Prez, Glessie Trafton, and Lucille Conklin. Mar. 1960. 50p. Contract W-7405-eng-36. OTS.

The metabolism of isoniazid was studied in tubercular and nontubercular patients following the intramuscular administration of from 200 to 300 μc of C^{14}-isoniazid. The metabolism was reinvestigated following daily oral administration of either pyridoxine or para-aminosalicylic acid (PAS) or sodium para-aminosalicylic acid (NaPAS) for 3 to 4 weeks. Findings are summarized. (C.H.)

8 LA-2440
Los Alamos Scientific Lab., N. Mex.
A STUDY OF TWO-STAGE AIR SAMPLERS DESIGNED TO SIMULATE THE UPPER AND LOWER RESPIRATORY TRACT. E. C. Hyatt, H. F. Schulte, C. R. Jensen, R. N. Mitchell, and G. H. Ferran. June 1960. 30p. Contract W-7405-eng-36. OTS.

Industrial hygienists have recognized for many years that there is a need for a suitable air-sampling device that could, in effect, be used to simulate man as a dust sampler. Such a device should be capable of distinguishing between the fraction of inhaled dust which would be retained in the upper respiratory tract and that in the alveoli. This study was made to determine the effectiveness of sturdy, low-volume two-stage air samplers suitable for environmental air sampling. Four two-stage air samplers utilizing inertial collection were studied with uranium aerosols. The standard against which the samplers were evaluated was the selective action of the respiratory system in dealing with dust particles of different aerodynamic sizes. The first stage of the two-stage sampler should be 90 to 100 per cent efficient in the range 5 to 10 μ and approximately zero at 1 μ. Detailed results are presented, giving particle-size data obtained on each fraction of the two-stage samplers studied and the efficiency of the first stage in the range 0 to 10 μ. (auth)

9 NYO-9432
Associated Nucleonics, Inc., Garden City, N. Y.
AN EXPERIMENTAL GAMMA IRRADIATOR FOR HOSPITAL STERILIZATION. J. H. Frankfort, S. Haram, and S. Wallach. Mar. 7, 1960. 94p. Contract AT(30-1)-2349. (AN-119). OTS.

Preliminary design data are presented for a gamma irradiator for use as an experimental hospital sterilizer. A photograph of a scale model and schematic sketches of design details are included. Initial-cost and operating data are considered for both Co^{60} and Cs^{137} sources. Among the materials particularly suited to gamma sterilization are bone transplants, rubber gloves, dressing packs, petrolatum gauze, and mattresses. (C.H.)

10 NYO-9433
Associated Nucleonics, Inc., Garden City, N. Y.
AN INDUSTRIAL GAMMA IRRADIATOR FOR MEDICAL SUPPLIES. J. H. Frankfort, S. Haram, Jr., and S. Wallach. Feb. 19, 1960. 139p. Contract AT(30-1)-2349. (AN-120).

Criteria were developed for the gamma sterilization of medical supplies and pharmaceuticals. Preliminary design data and cost figures are presented for a gamma irradiation. Both Co^{60} and Co^{137} are considered as gamma sources. Photographs of a model of a proposed irradiator and diagrammatic sketches of design details are included. (C.H.)

11 ORINS-36
Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.
THE LINEAR SCANNER IN CLINICAL STUDIES. Felix Pircher, Gould A. Andrews, Marshall Brucer, and D. A. Ross. Aug. 1960. 41p. OTS.

A linear scanner for use in localizing human radioisotope distribution is described. Results of linear scans of suitable patients who had received a radioisotope in the process of diagnosis or treatment are summarized. Diagnosis and medical histories of 14 cases are included, along with a brief description of physical and pharmacological properties of the radioisotopes used. (J.R.D.)

12 ORNL-2994(p.269-72)
Oak Ridge National Lab., Tenn.
INGESTION OF URANIUM COMPOUNDS. B. R. Fish, J. A. Payne, and J. L. Thompson.

Measurements of the absorption of uranium from the gastrointestinal tract into the bloodstream are being made in mongrel dogs. Seven dogs given single oral doses of UO_2F_2 absorbed 1.55% of the administered dose (standard deviation 0.21%), and their patterns of urinary uranium excretion rate do not appear to be significantly different from that seen in a study of intravenous injection of $UO_2(NO_3)_2 \cdot 6H_2O$ in dogs. (auth)

13 ORNL-2994(p.272-3)
Oak Ridge National Lab., Tenn.
DISTRIBUTION AND EXCRETION OF URANIUM. J. R. Muir, B. R. Fish, et al.

The study of the deposition of uranium in the rat kidney following intravenous injection of soluble uranium compounds, previously reported, was extended to a new dose level (0.001 μg of uranium per gram of body weight) and also extended in time to 6 months. There appears to be a different retention pattern for the various dose levels, the high doses being characterized by longer retention times in the kidney. (auth)

14 ORNL-2994(p.274-9)
Oak Ridge National Lab., Tenn.
AUTORADIOGRAPHIC STUDIES ON NONUNIFORM DISTRIBUTION OF URANIUM IN THE RAT KIDNEY. E. S. Jones, L. J. Casarett, et al.

A method, previously developed, of determining the nonuniform distribution factor, N, of uranium in the rat kidney by track counting in autoradiograms was carried forward and compared with the α activity in corresponding ashed material. Ten kidneys were counted. The greatest amount of activity was observed in the cortex of eight of these for which the average N is 1.33 and the range is 1.1 to 1.4. The ninth and tenth kidneys showed more activity in the medulla and gave an N_m of 1.5. For the results of six ashed kidneys, the average N was found to be 1.3 with a range of 1.06 to 1.48. (auth)

15 TID-6747
Montefiore Hospital, New York.
A STUDY OF STRONTIUM, CALCIUM, AND RARE EARTHS METABOLISM IN HUMANS. Annual Report [for] December 1, 1959 to November 30, 1960. Application for the continuation of work for December 1, 1960 to November 30, 1961. Herta Spencer. Oct. 10, 1960. 67p. Contract AT(30-1)-1763. OTS.

Studies on Sr^{85} Metabolism in Man. Induced enhancement of Sr^{85} excretion was studied with respect to removal of Sr^{85} in late phase, effects of chelating agents, and effects of stable strontium on Sr^{85} excretion. Total-body external counting of Sr^{85} was also carried out. Studies of Sr^{90} Metabolism in Man. Data from a study of 10 normal, healthy young people and one older person, under controlled dietary conditions, are tabulated. Studies Carried Out with Rare Earths. In humans, studies were made of

radioscandium excretion, plasma levels of Sc^{46}, and Sc^{46} removal. Metabolism of lanthanum and yttrium in mice was studied. Other studies included effects of excess chelating agents on rare-earth removal, in vitro studies with scandium, absorption of C^{14}-labeled chelation agents, and Cs^{137} distribution and excretion. (T.R.H.)

16 UCLA-460

California. Univ., Los Angeles. School of Medicine. SEMIANNUAL PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1960. 73p. Contract AT-04-1-GEN-12. OTS.

Summaries are presented from research in progress on the following studies: the isolation and cultivation of single-beating rat heart cells; physiological mechanism studies of acute pulmonary edema; the dosimetry of fast neutrons as determined by effects on semiconductors; the fate of lymphocytes that rapidly disappear from the blood after whole-body irradiation; the sensitivity of a large-sample gamma scintillation counter; the role of the reticulo-endothelial system in the pathogenesis of the anemia of inflammation, neoplasia, and radiation exposure; levels of nucleic acids in mouse leukemia; the protective effects of certain drugs against radiation injuries; studies of bone metabolism using radioisotopes; the design of a total-body counter facility; tracer studies in experimental liver disease; the chemical dosimetry of neutrons and gamma radiation; tracer studies of hepatobiliary disease using radiogold and rose bengal; the use of hippuran-I^{131} as an indicator of the functional impairment of one or both kidneys; the effects of x irradiation upon spontaneous and evoked brain electrical activity in cats; the toxicity of hafnyl chloride; the pharmacology of gadolinium and samarium chlorides; the effect of radiation from Sr^{90} beads implanted within the rat femur; thiamine transport across the isolated rat intestine; cell interaction studies in cell culture; effects of high specific activity tritiated compounds on E. coli; direct and indirect effects of irradiation on rabbit-liver mitochondria; effect of whole-body irradiation on liver mitochondria in chicken embryos; the metabolism of Zn^{65} in irradiated rats; the effect of dose fractionation on longevity of irradiated rats; life-shortening following 800 r x irradiation to the pelvis and hind extremities of rats; the effect of right and left body shielding on longevity of irradiated rats; the late effects of low-dose whole-body x irradiation on 4-day-old rats; mitochondrial effects on liver glycolysis; the effect of acetyl derivatives of thyroxin on acyl phosphatase; the effects of gamma radiation on dilute aqueous solutions of potassium oleate; the catalytic hydrogenation products of cis-9.10-epoxystearic acid; the metabolism of 8,11,14-eicosatrienoic acid; alterations in the lipids of the aging and chronically irradiated brain; the metabolism of 12-octadecenoic-1-C^{14} acid; the biogenesis of polyunsaturated fatty acids in fish; the biohydrogenation of fatty acids; the biogenesis of plant waxes; the mechanism of the Kolbe electrolytic reaction; the chemistry of macromolecules; the analysis of tissues for trace amounts of zinc, potassium, chlorine, phosphorus, copper, iron, calcium, and stable strontium; the effect of radiation on Dowex-50 resin; the importance of various primary products in the radiation-induced decomposition of ferriprotoporphyrin; the effect of pH and solution composition in the destruction of ferriprotoporphyrin by gamma radiation; the reaction of ferriprotoporphyrin with H_2O_2; radio-induced changes in nuclear fatty acids; the effect of irradiation on developing protein-synthesizing systems in chicken embryos; the ecology of the black-tailed jack rabbit at the Nevada Test Site; the role of ingestion and accumulation on fur on the radioactivity of animals exposed to fall-out; radiation effects on the growth of a population of native deer mice; the effect of the osmotic component of moisture stress upon the mineral composition of plants; the effect of soil moisture tension upon the mineral composition of plants; the influence of potassium and cesium on the uptake of Ce^{137} by bean plants grown in nutrient solution; the influence of chelating agents on the uptake of fission products by plants; problems in evaluation of data on Sr^{90} environmental contamination; the characteristics of fall-out from a nuclear power source (Kiwi A); the biological availability of Sr^{90} in selected locations along delineated fall-out patterns from continental weapons tests; the weathering of fall-out in selected areas; the effects of limestone in the root media on the nutrition of plants; the uptake by plants of mixed fission products from contaminated soils; and the influence of anion on plant uptake of Sr^{90} from contaminated soils. (C.H.)

17 UCRL-9233

California. Univ., Berkeley. Lawrence Radiation Lab. and Ohio State Univ., Columbus.

A STUDY OF THE MECHANICAL IMPEDANCE TO FLOW IN THE FEMORAL PERIPHERAL VASCULAR BED OF THE DOG. Howard M. Yanof and Ralph W. Stacy. July 7, 1960. 24p. Contract W-7405-eng-48. OTS.

The mechanical impedance to blood flow in the hind limb of the dog was studied, and a dynamic relationship among the various factors affecting blood flow was derived. The blood flow through the femoral artery was routed through external polyethylene tubing containing an electromagnetic flowmeter and a Statham pressure transducer. The pulsatile blood pressure and the blood flow were displayed simultaneously on a dual-beam oscilloscope and recorded on 35-mm film. The pressure and the flow curves were then analyzed for their respective Fourier component frequencies. The Fourier analysis was performed with a frequency converter and a wave analyzer. The mechanical impedance is calculated by dividing the amplitude of each pressure harmonic by the amplitude of the corresponding flow harmonic. The average mechanical impedance vs. frequency curve has two resonant frequencies: one between 3.6 and 4.6 cps and the other between 5.6 and 7.0 cps. The impedance has a minimum value of about 1.2 peripheral resistance units at each resonant frequency. The flow vs. frequency and the pressure vs. frequency curves are also described. A theoretical electrical analog is hypothesized. This circuit consists of two arms in parallel, each arm containing an inductance and a resistance in series with a parallel capacitance and resistance. The impedance equations for the analog circuit are derived, and the impedance-frequency curve of the circuit is qualitatively constructed. This constructed curve agrees with experimental observation. The dynamic relationships existing among the elastance, inertial, and frictional factors affecting blood flow are discussed. (auth)

18 UCRL-9375

California. Univ., Berkeley. Lawrence Radiation Lab.

A NEW TRAPEZOIDAL-WAVE ELECTROMAGNETIC BLOOD FLOWMETER AND ITS APPLICATION TO THE STUDY OF BLOOD FLOW IN THE DOG (thesis). Howard M. Yanof. Aug. 25, 1960. 72p. Contract W-7405-eng-48. OTS.

The electromagnetic flowmeter measures the velocity of a fluid moving in a tube or pipe. By constraining the vessel in a sleeve, flow may be measured directly. A magnetic field crosses the tube to the plane of the electrodes. As the ions in the fluid pass the magnetic field, a voltage is induced across the electrodes. This flowmeter is different from existing flowmeters because of the unique trapezoidal

wave form that energizes the magnet. The trapezoidal-wave electromagnetic blood flowmeter is described and compared to other types of electromagnetic flowmeter. The construction of the transducer elements is discussed. The calibration of the transducer element to measure blood flow in the dog is also discussed. Preliminary measurements were made of blood flow in the hind limbs of dogs. Total femoral artery flow was compared with the effective tissue flow in two normal anesthetized dogs, and in another dog in response to an infusion of norepinephrine and in response to an injection of epinephrine. Total femoral artery blood flow was also measured after intra-arterial injections of norepinephrine, histamine, procaine, aminophyllin, and Pitressin and intravenous injections of adrenalin and norepinephrine. (auth)

19 AEC-tr-4131

ON THE QUESTION OF THE METABOLISM OF RADIO-RUTHENIUM IN THE WHITE MOUSE. I. DISTRIBUTION AND EXCRETION OF CARRIER-FREE Ru^{106} AFTER DIFFERENT FORMS OF ADMINISTRATION. E. Spode and F. Gensicke. Translated by Gretchen Riese (Los Alamos Scientific Lab.) from Strahlentherapie 111, 266-72(1960). 11p. JCL.

The metabolism and biological effects of Ru^{106} in mice were studied. Data on tissue distribution are tabulated. (C.H.)

20 JPRS-2623

RADIATION CHIMERAS AND THERAPY OF RADIATION INJURIES. A. S. Shevelev (Shevelov). Translated from Priroda 49, No. 1, 20-5(1960). 10p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13627.

21 JPRS-2773

MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya Volume IV, No. 6, pages 3-55; 61-93; 95-6, 1959. 157p. OTS.

22 JPRS-2773(p.1-21)

THE PROBLEM OF THE PROPER USE OF THE X-RAY METHOD OF EXAMINATION. Yu. G. Grigor'ev (Grigoryev), M. P. Andreeva (Andreyeva), L. N. Kvasnikova, T. M. Pimenova, and Z. K. Chufirina. Translated from Med. Radiol. 4, No. 6, 3-15(1959).

The increased use of diagnostic x rays and fluoroscopies all over the world in recent years is pointed out by the use of data from several sources. (T.R.H.)

23 JPRS-2773(p.106-9)

MATERIAL ON THE DISTRIBUTION OF Pm^{147}. Yu. I. Moskalev. Translated from Med. Radiol. 4, No. 6, 73-5 (1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16707.

24 JPRS-2773(p.114-20)

THE PENETRATION OF RADIUM BROMIDE THROUGH THE INTACT SKIN OF ANIMALS. M. A. Khodyreva. Translated from Med. Radiol. 4, No. 6, 77-82(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16709.

25

IRRADIATION OF LIPOSARCOMA. Milton Friedman and John W. Egan (New York Univ. Coll. of Medicine and Hospital for Joint Diseases, New York). Acta Radiol. 54, 225-39(1960) Sept. (In English)

The response to supervoltage roentgen treatment (2 Mv) of 15 liposarcomas, in 12 patients, was analyzed, the tumors being classified according to the histologic degree of malignancy. It was found, paradoxically, that the differentiated liposarcomas were more radiosensitive than the undifferentiated lesions. Irradiation can only occasionally contribute toward a cure. The tumor lethal dose ranges from 6000 to 9000 rads in 30 to 50 days, and a useful palliative dose is 3000 to 4000 rads in 20 to 30 days. The prolonged natural life history of many liposarcomas requires a 10-year follow-up for evaluation of the treatment. (auth)

26

OSTEOCLASTS AND THE AGING SKELETON: A CYTOLOGICAL, CYTOCHEMICAL, AND AUTORADIOGRAPHIC STUDY. Edgar A. Tonna (Brookhaven National Lab., Upton, N. Y.). Anat. Record 137, 251-60(1960) July.

Results are reported from a cytological study which included an estimation of the periosteal and metaphyseal osteoclastic population and its distribution in the femurs of rats and mice from birth to old age. 46 references. (auth)

27

THE MEASUREMENT OF BLOOD VOLUME IN PATIENTS WITH POLYCYTHAEMIA VERA TREATED WITH P^{32} P. Czermiak and L. Lauer (Hôpital d'Etat Tel Hashomer, Israel). Ann. radiol. 3, R.101-7(1960). (In French)

A technique is given for measuring the blood volume by labeling red cells with radioactive chromium and incubating in vitro for either 2 hr or 10 min. This technique was applied to 34 cases with Vaquez's disease (polycythaemia vera) before and after treatment with P^{32}. The figures obtained are compared with those already published in the literature and with those of a group of normal individuals acting as controls. Blood volume measurement gives important information, notably for the differential diagnosis between polycythaemia vera and secondary polycythaemia or that due to stress, for the early diagnosis of possible relapse, and for the estimation of the functional and biological state of the marrow. Finally, it makes possible more exact dosage for treatment with P^{32} (auth)

28

PROBLEMS OF DOSIMETRY IN TELECOBALT THERAPY. D. E. A. Jones (Mount Vernon Hospital, Northwood, Middx., Eng.). Ann. radiol. 2, R.159-65(1959). (In French)

The main advantages of telecobalt therapy, as compared with therapy at 200 to 300 kv, are briefly reviewed. These result from the lesser importance of scattered photons and the predominance of forward scatter, the much smaller difference in the dose absorbed within tissues of different composition, and the smaller reduction in the radiation transmitted through an intervening screen of bone. The build-up effect of the incident dose in the first few millimeters of tissue and the preparation of isodose charts for moving field therapy are discussed. (auth)

29

SHIELDING EFFECT OF A BONE LAYER. Andrée Dutreix, J. Dutreix, and Maurice Tubiana (Institut Gustave-Roussy, Villejuif, France). Ann. radiol. 2, R.389-97(1959). (In French)

The shielding effect of a bone layer depends upon the atomic composition of the bone, its density, and also the characteristics of the radiation beam. The reduction factor becomes smaller as the radiation energy increases. In the case of a high-energy beam (cobalt γ rays), this reduction depends solely upon the density of the bone and the area of the field. The variation due to the depth of the bone and the distance between the bone layer and the point considered can be neglected. As the radiation energy decreases, the influence of these factors increases. At 200 kv the reduction factor due to the interposition of a bone layer is of the

order of 35% in the case of a bone 4 cm thick. This correction factor varies in a complex manner with different irradiation conditions, but the variations represent less than one-tenth of the reduction factor. These variations are greater at 160 kv. They can be explained by two phenomena: a filtration effect exerted by the bone on the incident radiation and an increase in the scattered radiation. (auth)

30

RADIOTOXICOLOGIC ANALYSIS OF URINE. L. Jeanmaire and H. Jammet (Commissariat à l'Énergie Atomique, Saclay, France). Ann. radiol. 2, R.703-22(1959). (In French)

The article is divided into two parts: general and technical. In the general part, a study of the behavior of radioisotopes in the organism shows the hazards of internal contamination. In addition, the principle of the different methods for the estimation of this contamination is indicated. The second part, which is purely technical, describes some of the methods for urine analysis used in the S.H.A.R.P. radiotoxicology laboratory at the Saclay Nuclear Research Centre. The techniques relate to Pu^{239} Ra^{226}, Sr^{90}, natural Th, natural U and U^{233} (auth)

31

DIFFERENCES IN RADIOSENSITIVITY OF DEOXYRIBONUCLEOPROTEINS AND DEOXYRIBONUCLEIC ACID. P. I. Tseitlin, T. Yu. Ugarova, V. Yu. Klimov, and T. D. Sokolova (Inst. of Experimental Biology, Academy of Medical Sciences, Moscow). Biochemistry (U.S.S.R.) (English Translation) 25, 92-6(1960) Aug.-Sept.

Nucleoproteins with different protein contents were obtained and characterized. When dilute solutions are irradiated by X rays (dose 5000 r), DNP with N/P < 2 (DNA) has greater radiosensitivity than DNP with N/P > 2. The starting DNP, as distinct from the DNA, does not show consequential effect. (auth)

32

CINEDENSIGRAPHY WITH RADIOISOTOPES: A NEW TECHNIQUE FOR STUDYING THE MOVEMENTS OF INTRATHORACIC ORGANS. R. Dugnani Lonati, C. Garavaglia, and T. Nichelatti (Università, Milan and Centro Informazioni Studi Esperienze, Milan). Energia nucleare (Milan) 7, 555-8(1960) Aug. (In English)

After a brief description of the principles of cinedensigraphy (electrokymography), a variation of this method, obtained by replacing the x-ray tube with a radionuclide source (Tm^{170}) is presented. The experimental conditions of the research work are described, and the various new advantages of this technique are set out, namely, apparatus simplicity, more precise recording, and possibility of studying the movements of the intrathoracic organs with the source located inside the organism. Finally, preliminary results obtained in the study of lung function are reported. (auth)

33

MEDICAL APPLICATIONS OF NUCLEAR INDICATORS. C. Kellershohn (Université, Paris) and P. de Vernejoul. Inds. atomiques 4. No. 7-8. 52-61(1960). (In French)

The general principles for the utilization of radioisotopes as tracers for the measurement of volume or flow of a biological fluid. for the measurement of the "pool" or velocity of renewal of a constituent participating in metabolism. and for the "visualization" of the distribution of a substance in the human organism are explained. The applications to the measurement of biological volumes, measurement of electrolytic "pools," study of cardiac hemodynamics, measurement of hepatic blood flow, study of the thyroid function, and to the determination of traces in the blood by activation analysis are then considered. The conditions that must be fulfilled so that a service specializing in the application of tracers in medicine can function correctly are discussed. (tr-auth)

34

AN EXPERIMENTAL STUDY OF THE [BODY] WATER BALANCE WITH HEAVY WATER. III. EXPERIMENT IN AN ENVIRONMENT OF HIGH TEMPERATURE. Koshiro Hakoishi (Osaka City Univ.). Ôsaka Shiritsu Daigaku Igaku Zasshi 8, 2101-17(1959) Dec. (In Japanese and English)

Results are reported from studies of the effects of environmental high temperatures on body water balance in dogs, in which heavy water was used as a tracer. Measurements were made daily of the change of body weight, the density of heavy water in the blood, the volume of blood corpuscles, and the amount of heavy water excreted into urine and feces. Immediately prior to incipient death due to heat, the animals were bled to death and the heavy-water content in blood and tissues was measured. Results were compared with the movement in the body of heavy water. Results are summarized. (C.H.)

35

DESIGN AND PERFORMANCE OF FIELD-DEFINING APERTURES FOR NEUTRON CAPTURE THERAPY. E. E. Stickley and L. E. Farr (Brookhaven National Lab., Upton, N. Y.). Radiology 75, 602-7(1960) Oct.

Special radiological problems are discussed which arise when a nuclear reactor or atomic pile is used in medical research and experimental radiation therapy. While there are many and various ways in which this new tool can be used, the principal emphasis here is toward the means and the devices that are utilized in order to control the energy spectrum of the external neutron stream and to direct it selectively to the treatment site. (auth)

36

REDUCTION OF FETAL IRRADIATION IN PELVIMETRY. Tom A. Kendig (Harriman Jones Medical Clinic and Hospital, Long Beach, Calif.). Radiology 75, 608-11(1960) Oct.

It is important to recognize the growing concern as to the possible significance of general body irradiation of the fetus in the course of pelvimetry. To reduce this appreciably there are only two really satisfactory alternatives, either to eliminate the procedure entirely or to refine the technic so that the fetus obtains only a fraction of the exposure incident to the more conventional method of pelvimetry. This latter object was achieved to a highly satisfactory degree by precision coning, precision centering, masking the area where the fetal head lies, and protecting the remainder of the fetus by a leaded apron placed over the maternal abdomen. (auth)

37

STERILIZATION OF PHARMACEUTICALS AND HOSPITAL SUPPLIES BY IONIZING RADIATION. Ch. Artandi and W. Van Winkle, Jr. (Ethicon, Inc., Somerville, N. J.). p.249-60 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

The pharmaceutical industry was in need of a method of sterilization of proteins, enzymes, steroids, and other sensitive materials which does not involve heat or very reactive chemicals. Ionizing radiation can successfully be used to destroy microorganisms at doses which are harmless to most of these compounds. This new method of sterilization has three important advantages: (1) The final sealed pack-

age can be sterilized. (2) New, less expensive, and more convenient packaging materials may be used (plastics). (3) Easy adaptability for continuous process. Electron accelerators (Van de Graaff electrostatic or linear accelerators) should be the preferred sources of radiation, whenever penetration of the product is no problem. Gamma emitters and x-ray machines provide great penetrating power, but their dose rate is low and good utilization of energy requires complex engineering designs due to the problems of geometry. The performance of the electron accelerators can be routinely checked by meters, monitors, and recorders. Various dosimetry systems are available for the calibration of machine performance and spot check of production. Irradiation is not economical for products which can be sterilized by heat. Its higher cost is only of secondary importance when a quick and efficient method is needed for sterilizing sensitive materials. Sutures of all kinds, dressings, ointments, enzymes, injectibles, and other items are being sterilized on production scale by irradiation, and the field is open for many more products. (auth)

38

STERILIZATION OF MEDICAMENTS BY GAMMA RAYS. NOTE I. AMPOULES CONTAINING DISTILLED WATER. D. Arizan (Inst. of Scientific Studies, Bucharest), A. Constantinide, P. Adrian, M. Cancea, S. Baliu, M. Rosetti, F. Stanesco, and V. Cosma. p.261-71 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In French)

The industrial use of cold sterilization by radiations was studied. It consisted of the following stages: (1) Ampoules of distilled water were exposed to various doses of gamma rays from a Co^{60} source; (2) The radiation doses sufficient to sterilize ampoules of distilled water prepared under industrial conditions were found; (3) The work was supplemented by a study of the doses required to sterilize ampoules artificially contaminated with a number of aerobic and anaerobic germs in various concentrations; (4) With a view to performing the process on an industrial scale, a study was made of the action of gamma rays emitted by uranium fission products; (5) Systems and tentative equipment were devised for both the Co^{60} source and the fission products; (6) The conclusion is that cold sterilization by radiation can be applied to the industrial production of distilled water ampoules with considerable economic advantages; and (7) This work is the first part of a general project on which research continues. (auth)

Biochemistry, Nutrition, and Toxicology

39 TID-3531(1st Rev.)

Office of Technical Information Extension, AEC.

TOXICITY AND HAZARDS OF BERYLLIUM AND ROCKET PROPELLANTS. A Literature Search. William E. Bost, comp. Oct. 1960. 22p. OTS.

References are given to 145 unclassified reports on toxicity, occupational hazards, and safety measures regarding beryllium and certain chemicals which have been used or considered for use as rocket-propellant constituents. Among the latter are fluorine, hydrogen, hydrazine, boranes, borohydrides, nitric acid, nitrogen oxides, hydrogen peroxide, ammonia, ozone, chlorine trifluoride, and lithium hydride. (auth)

40

TRITIUM RADIOACTIVITY DETERMINATION OF BIOLOGICAL MATERIALS BY A RAPID DRY COMBUSTION TECHNIQUE. Edwin A. Peets, James R. Florini, and Donald A. Buyske (American Cyanamid Co., Pearl River, N. Y.). Anal. Chem. 32, 1465-8(1960) Oct.

In pharmacological and biological research it is often necessary to determine the tritium radioactivity of a large number of samples of biological materials having varied specific activities. A practical method of measuring the radioactivity of large numbers of such samples is dry combustion of the material to water and carbon dioxide and determination of the radioactivity of the products using a liquid scintillation spectrometer. Since the currently available apparatus can accommodate only single samples of relatively small size, a furnace was designed which makes possible the rapid simultaneous combustion of three samples of up to 2 g dry weight. (auth)

41

DETERMINATION OF I^{131}, Cs^{137}, AND Ba^{140} IN FLUID MILK BY GAMMA SPECTROSCOPY. G. Richard Hagee, Gerald J. Karches, and Abraham S. Goldin (Robert A. Taft Sanitary Engineering Center, Cincinnati). Talanta 5, 36-43 (1960) July.

The radionuclides I^{131}, Cs^{137}, and Ba^{140} were determined in fluid milk by multichannel gamma spectroscopy, using a heavily shielded 4" × 4" sodium iodide (thallium-activated) crystal as a detector. The contribution of each of the above nuclides, and also of the naturally occurring K^{40} and background, to the composite gamma spectrum was determined by means of simultaneous equations describing their mutual interferences. No sample preparation was required for the analysis. The sensitivity of the method is about 10 μμc/liter, with an accuracy of about 5 to 10 μμc/liter when the nuclides are present at levels up to about 50 to 100 μμc/liter. At higher levels the precision and accuracy are about 5 to 10%. (auth)

Fallout and Ecology

42 HW-63824(p.25-32)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

RADIOACTIVITY IN FOODS RESULTING FROM COLUMBIA RIVER WATER RADIOISOTOPES. R. W. Perkins and J. M. Nielsen.

Water from the Columbia River is used as a coolant for the Hanford reactors. The subsequent disposal of this water to the river introduces trace amounts of several induced radioisotopes, most of which have half lives on the order of minutes to a few hours; however, the half lives of some of these isotopes are sufficiently long to trace their distribution through the food chains of the aquatic life in the river, and some can be traced from irrigation water through farm produce to man. Results are reported from a comprehensive study of the radioisotopes present in farm produce irrigated by the Columbia River. The radioisotopes present in sea foods that were harvested from waters near the mouth of the Columbia River were measured and compared with those present in sea foods from several other locations in the world. (auth)

43 HW-63824(p.33-8)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

MEASUREMENTS OF THE FALLOUT RADIOISOTOPES

ON VEGETATION AND AIR FILTERS WITH A LARGE SCINTILLATION WELL CRYSTAL. R. W. Perkins.

In the operation of nuclear reactors and the associated chemical processing plants, the possibility of an accidental discharge of radioisotopes in the gaseous effluents is of vital concern. In addition to the automatic monitoring equipment on these gaseous effluent lines, air filter samples are collected daily and weekly from many locations within the plant perimeter and from several offsite stations ranging up to 400 miles from the plant. In addition, vegetation samples from designated zones both within the plant perimeter and at distances up to several hundred miles radius from the plant are sampled weekly to detect any radioisotope contamination resulting from plant operation. During the past several years of atomic weapons testing, the problem of detecting any plant contamination became increasingly difficult because of the presence of radioisotopes resulting from fall-out. In 1957 a γ-ray spectrometric system of analysis was devised and put into operation for the measurement of the fall-out radioisotopes and radioisotopes released by plant operation. The procedure involved counting a 150 g sample of vegetation on a 3-in. diameter by a 3-in. thick NaI(Tl) detector-multichannel analyzer system. From the resulting spectrum, the net counting rates and the disintegration rates of each of the radioisotopes were calculated. This procedure provided a reasonably good sensitivity for the detection of any plant radioisotope emission but was limited by the high background due to fall-out. An efficient sample-detector system is described which provides a considerable sensitivity improvement in the measurement of fall-out and plant effluent radioisotopes on vegetation and air filters. Data are tabulated. (auth)

44 ORNL-2994(p.147-66)

Oak Ridge National Lab., Tenn.

ECOLOGICAL RESEARCH. WHITE OAK LAKE BED STUDIES. S. I. Auerbach, D. A. Crosley, Jr., et al.

The biological community developing on the contaminated White Oak Lake bed illustrates the movement of Sr^{90} and Cs^{137} from soil to plants to animals. Little change in soil Sr^{90} from 1958 to 1959 suggests a decrease in former losses owing to physical processes. In the upper soil, Cs^{137} and Co^{60} have remained almost the same (except for decay) since the lake was drained. Morphological features in two plant species (sedges) are affected more by the different site factors on the lake bed than by the differing dose rates. Rates of uptake of radionuclides by plants (smartweed) decrease relative to rates of plant growth throughout the growing season. Only a minute fraction of the Sr^{90} and Cs^{137} taken up by plants is found in the insects at any one time, but laboratory studies of elimination rates led to estimates that about 3 to 5% of the radionuclides taken up by plants pass through the insects in the ecosystem. Analyses of IBM data for over 4300 small-mammal captures from the lake bed and other study areas include estimations of population parameters for small mammals, which are significant for new work on radiation effects. Radioassay studies of the small mammals show that concentrations of Cs^{137} in insect and mammal herbivores per unit area are similar, but the concentration of Sr^{90} is three times as high in mammals as in insects. (auth)

45 ORNL-2994(p.167-85)

Oak Ridge National Lab., Tenn.

FOREST STUDIES. J. S. Olson, W. C. Cate, et al.

Theoretical studies included the use of analog computers to simulate the cycle of movement of chemical elements and isotopes through ecological systems. In 1959 to 1960, studies emphasizing methodology were illustrated by the flow of carbon and C^{14} in very simple model systems. Direct extensions should help predict how rapidly other isotopes might become distributed in more complex systems. Tracer experiments on translocation in dogwood trees showed how Sr^{85} lags behind Ca^{45}, while both lag far behind K^{42}. Like K^{42}, Cs^{134} in white oaks moved rapidly from trunks into foliage, then quickly began leaching out of intact or plucked leaves, and started reappearing in other plants within a few weeks—a rapid ecological cycle. Slower movements of Ru^{106}, Co^{60}, and Sr^{85}, which were introduced in tagged tree litter on top of soil, were approximately proportional to the rate of litter weight loss. New work on soil arthropods, bacteria, and fungi is helping to explain large differences in the rate of litter breakdown, which was measured in conifer and deciduous forests of Oak Ridge and the Great Smoky Mountains. These studies, and others on biomass and productivity of pine forests, included extensive chemical and γ-spectrometric analyses. The latter provided new information on several local sources of radioactive contamination. A vegetation and soil survey is helping to plan future experiments and land use in the Oak Ridge AEC-controlled Area. (auth)

46 ORNL-2994(p.186-90)

Oak Ridge National Lab., Tenn.

CLINCH RIVER STUDIES. D. J. Nelson, R. C. Early, et al.

The first year of Clinch River investigations determined which species of bottom organisms were present and their relative abundance. Tubificid worms are being used as an experimental organism for uptake and excretion studies with radioisotopes, and their role in the turnover and transport of river-botton sediments is being evaluated. Chronic low-level radiation effects on bottom organism populations are being studied by means of chromosome analyses of the salivary glands of Chironomus tentans larvae. Crayfish, Cambarus longulus longerostris Ort., have been used in the study of the uptake and excretion of Sr^{85}, and similar investigations are now under way with Co^{60}. (auth)

47 TID-6630

Hawaii. Univ., Honolulu. Hawaii Marine Lab.

UPTAKE OF RADIOISOTOPES AND THEIR TRANSFER THROUGH FOOD CHAINS BY MARINE ORGANISMS. ANNUAL REPORT, 1959–1960. Sidney J. Townsley, Della F. Reid, and Winifred T. Ego. 45p. Contract AT(04-3)-56. OTS.

The results of experiments performed to elucidate the mechanism by which the cichlid Tilapia mossambica maintains its osmotic equilibrium are reported. Using the previously designed compartmentalized tank, measurements were made to show the ability of these fish to absorb strontium and sodium ions directly from the environment. All routes of absorption and excretion were studied under variable experimental conditions. Sr^{85} was used to measure Ca^{++} and Sr^{++} discrimination by fish. Analysis of the data shows that more of these cations pass through sea-water adapted fish than through fresh-water adapted fish, although in the former case a smaller quantity of radioactivity is measured. The difference between the quantity of these ions excreted in the urine could not account for the apparent discrimination in the fish. Experiments using Na^{22} to study sodium activity show that rapid exchange of sodium occurs in both sea-water and fresh-water adapted fish. Because of the results obtained in these experiments, preliminary tests were performed to show what effect stress and adrenocortial hormones may have on the selective absorption and excretion of ions. The entire body surface of Tilapia is permeable,

and it is presumed that this permeability may be altered under stress and/or hormonal activity. No clear stress relationship has been obtained as yet; however, it appears that DOCA increases the permeability of the entire surface of the fish to Na^{22}, resulting in an increased accumulation and output of approximately twice that in the control fish. Results of two artificial food-web experiments are presented. Using Zn^{65} to label sea water, results of experiments on the radiozinc accumulation by Chlamydomonas, Artemia salina, and Chaetodon miliaris directly from solution and through feeding are presented. It is postulated that direct absorption from sea water will be the most important method for accumulation of this element by these organisms. Because planktonic and benthic organisms appear to concentrate trace ions in the marine ecosystem, initial studies were employed to show what effect chemical changes in the environment may have on the accumulation of isotopes by representative organisms. Data obtained on Chlamydomonas, Artemia salina, and the brachiopod Lingula reevi, exposed to sea water containing Na^{22}, are presented. It is found that the sodium in these organisms reaches an equilibrium with the environment very rapidly. Indications point to the fact that the quantity of Na^{22} accumulated is related to the ability of the organisms to regulate and selectively absorb ions. Data on the relationship of organ size to fish size are presented. Comments on the handling and use of Tilapia mossambica for laboratory procedures are also included. (auth)

48 DEG-Inf-Ser-101

NEW DATA ON THE EFFECT OF THERMONUCLEAR EXPLOSIONS ON AQUATIC ORGANISMS. P. A. Moiseev. Translated by G. R. Taylor from Rybnoe Khozy. 34, No. 1, 22-4(1958). 4p.

Results are reviewed from a number of investigations of the radioactivity of water and aquatic organisms of the Pacific Ocean following thermonuclear explosions. Data are tabulated on the Sr^{90} content of sea water and the bones of various fishes collected at a number of locations during 1956 and 1957. These data indicate that the testing of thermonuclear explosives in the Pacific basin has resulted in high levels of radioactivity of practically all the water masses filling the western part of the Pacific Ocean. (C.H.)

49

GAMMA ACTIVITY IN MILK. A. S. Chhabra and R. K. Hukkoo (Atomic Energy Establishment, Trombay, India). J. Sci. Ind. Research (India) 19B, 302-5(1960) Aug.

Samples of milk powder from different parts of the world were analyzed for γ activity using a large NaI (Tl) scintillation crystal and a 30-channel pulse-height analyzer. The γ activities found in these milk powders were partly owing to their natural K^{40} content and partly to the Cs^{137} from fall-out. The amount of Cs^{137} in the samples was found to vary from country to country, indicating a strong latitude dependence with a peak in the middle latitudes of the northern hemisphere and a minimum in the equatorial and polar regions. The method employed for the calibration, under appropriate conditions of geometry, of the instruments used in the analysis is discussed in detail. (auth)

50

ACCUMULATION OF RADIOISOTOPES FROM FALLOUT BY TERRESTRIAL ANIMALS AT HANFORD, WASHINGTON. W. C. Hanson (General Electric Co., Richland, Wash.). Northwest Sci. 34, 89-98(1960).

Observations are reported of the bioaccumulation of airborne radioactive contamination from nuclear weapons tests and Hanford plutonium separations facilities in animals from natural populations on the Hanford reservation. Most information was obtained from jack rabbits collected at 15 stations established throughout the Hanford reservation. A seasonal pattern of I^{131} concentrations similar to that previously reported occurred at all collection stations and closely paralleled the inert iodine content of thyroid tissue. Radioactive debris from distant nuclear weapons tests resulted in a tenfold increase in I^{131} concentrations in thyroid glands of rabbits, with little station-to-station variance. Thyroid glands of full-term fetuses of rabbits consistently contained greater I^{131} concentrations than thyroids from parent animals. Values after birth decreased with increasing age until two months, at which time levels comparable to adult animals were maintained. Concentrations of mixed fission products in bone, liver, muscle, and feces samples of rabbits maintained relative stability during the 19-month study. No sustained upward trend was noted. Eight days after a "rainout" of bomb test debris, concentrations of fission products in feces showed an immediate tenfold increase. Concentrations in liver and bone samples increased, but at a much slower rate than in feces samples. Thirty-eight days after the "rainout," the fission product concentrations in both liver and feces decreased to near "prerainout" levels, but concentrations in bone continued to increase for an additional 30 days. Young rabbits consistently contained greater concentrations of fission products than adult animals. Greatest concentrations of radioisotopes other than I^{131} appeared immediately following birth, with values decreasing slightly as the rabbits grew to maturity. Greatest I^{131} concentrations appeared in thyroids of full-term fetuses of rabbits, and decreased to maturity. Fission product concentrations in respective tissues of all kinds of animals sampled were essentially equal, irrespective of distance from Hanford process stacks. Fission product isotopes that were collected eight days after a "rainout" included Sr^{90}, Zr^{95}-Nb^{95}, Mo^{99}, Ru^{106}, Ru^{103}, I^{131}, Ba^{140}, Ce^{141}, Ce^{144}, and Cs^{137}. Sixty per cent of the total radiostrontium concentration of the bone was Sr^{90}, the remainder being Sr^{89}. (auth)

51

SAMPLING AND ANALYSIS OF RADIOACTIVE FALL-OUT IN PRECIPITATION, PEAT SOIL, VEGETATION, TAP WATER, AND MILK. H. Bergh, G. Finstad, L. Lund, B. Ottar, and T. Wik (Forsvarets Forskningsinstitutt, Kjeller, Norway). Svensk Kem. Tidskr. 71, 695-716(1959). (In Norwegian)

The pattern of radioactive fall-out in Norway was followed in three meteorologically and topographically different areas from 1957 to 1959. It is shown that only part of the Sr^{90} and Cs^{137} deposited is brought down by precipitation. In open areas with less precipitation, increasing amounts of radioactive fall-out are brought down by turbulent deposition. The concentration of Sr^{90} and Cs^{137} in tap water is only from $\frac{1}{5}$ to $\frac{1}{10}$ of that found in precipitation. In milk the content of Sr^{90} and particularly Cs^{137} has increased from year to year and shows marked seasonal variations. (auth)

52

DETERMINATION OF RADIOACTIVE STRONTIUM IN NORWEGIAN CORN AND CORN PRODUCTS AND IN ANIMAL AND HUMAN BONES. Jorolf Alstad, Arve Kjelberg, Anton Fr. Olsen, and Alexis C. Pappas (Universitetet, Oslo). Svensk Kem. Tidskr. 71, 717-20(1959). (In Norwegian)

An improved method for the determination of radioactive strontium in cereals and in animal and human bones, to-

gether with the results of measurements in Norwegian samples from 1957 to date, are presented. In cereals a 50 to 100% increase is found in the average amount of Sr^{90} for 1958 as compared to 1957. Mountain deer show an increase by a factor of 10 during a period of 2 yr. Human (0 to 30 yr) bones contained an average of 1.0 SU in 1956 and 2.2 SU in 1958. The maximum amount found to date is 7.5 SU in a sample from a ¾-year-old child from the western part of Norway. (auth)

Radiation Effects on Living Tissues

53 A/AC.82/G/L.364

Sweden. Försvarets Forskningsanstalt, Stockholm.

THE GENETIC BACKGROUND TO THE REACTIONS OF VARIOUS MOUSE STRAINS TO X-RAYS. I. LETHALITY FOLLOWING ACUTE IRRADIATION. H. Frölen, K. G. Lüning, and C. Rönnbäck. Apr. 1960. 26p.

The difference of x-ray sensibility in various strains of mice was investigated as a base of further investigations. Males from the three strains (albino, CBA, and C3H) and F_1 and F_2 from crosses between them were irradiated with different doses of x rays. The $LD_{50/30}$ dose for each group of animals was computed. The results obtained show that resistance is not only a result of dominant genes but also of additive or recessive genes. (auth)

54 HW-63824(p.55-8)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SUSCEPTIBILITY OF SOLUTES TO ATTACK BY FREE RADICALS IN AQUEOUS SOLUTION. D. R. Kalkwarf.

Several current theories for the damaging action of ionizing radiation on a system consider that a significant amount is caused indirectly by the free radicals formed during the irradiation process. In aqueous systems, which include living organisms, the weight predominance of water suggests that free radicals derived from it are the major contributors to this indirect effect. One method for protecting such a system would be to add a compound that reacts rapidly with these radicals before they are able to attack other components. Relative rate constants of such reactions have already been measured for a large number of compounds by allowing each to compete with the dye, erioglaucine, for the radicals formed in irradiated aqueous solutions. These constants, termed "protection indices," quantitatively measure the reactivity of radicals with various chemical structures on an equimolar basis. Their magnitudes vary over a wide range; for example, the protection index of SCN^- was found to be 8×10^{-1} whereas that for $SO_4^=$ was found to be 2×10^{-4}. Although protection indices can be determined rapidly by the colorimetric technique, contemplation of the number of chemical species in existence prompts the search for methods of predicting values from data already in the literature. One large collection of data exists as values for the parameters of the Hammett linear free-energy relationship. This relationship predicts that if k_0 is the rate constant for the reaction between a reagent and an aromatic compound, and if k is the constant for the corresponding reaction in which the aromatic compound has an additional ring substituent, X, then $\log (k/k_0) = \rho\sigma$. In this equation, ρ is a constant dependent on the type of reaction and σ is a constant dependent on the substituent. Since relative rate constants (e.g., protection indices) should be related in a similar way, experimentally-determined indices for a group of substituted benzoic acids and literature values of the substitutent constants σ were prepared. The available data fall on a straight line as predicted by the equation with a slope of -0.31 for the constant ρ. Protection indices of other substituted, benzoic acids can now be calculated from this parameter and literature values of σ for which extensive lists are available. It is interesting to note that radicals react most rapidly with benzoic acid derivatives containing substituents with large negative σ-values, corresponding to a large electron-donating tendency of the substituent toward the ring. Another use of protection-index values is to recognize which normal constituents of a system are most susceptible to attack by free radicals. This is particularly important in the case of living tissue since it is still uncertain which metabolic processes at the molecular level are most affected by the absorption of ionizing radiation. Identification of these critical processes would be a significant step toward protecting a living organism from damage. Experimentally determined protection indices are tabulated for a group of natural metabolites found in living tissue. Of particular interest is the observation that the three α-amino acids represented react relatively slowly with free radicals. (C.H.)

55 NYO-9396

Long Island Biological Assn. Biological Lab., Cold Spring Harbor, N. Y.

THE STUDY OF SPONTANEOUS AND INDUCED GENETIC CHANGES IN MAMMALIAN CELLS GROWN IN TISSUE CULTURES. Summary Report [for] Period June 15, 1956–June 14, 1960. H. Moser. 29p. Contract AT(30-1)-1944. OTS.

Progress is reported in studies on genetic, lethal, and semilethal effects of radiation on human cells in culture. Data are included on the nutritional requirements and cultural procedures for the growth of long-term cultures of human somatic cells with stable normal-diploid karyotype. A list of papers published during the period is included. (C.H.)

56 ORNL-2994(p.241-50)

Oak Ridge National Lab., Tenn.

PHYSICS OF TISSUE DAMAGE. R. D. Birkhoff, J. G. Carter, and D. R. Nelson.

Radiation-induced thermoluminescence was studied for 4 proteins and 23 l-amino acid preparations. The powdered crystalline samples were irradiated at liquid-nitrogen temperature and subsequently warmed to room temperature. Glow curves (plots of intensity of light emission vs. temperature) are presented for these preparations. From considerations of the intensities of peaks in the glow curves and the temperatures at which they occur, four conclusions are drawn. The glow curves from proteins are not the sum of the glow curves of the constituent amino acids (properly weighed for per cent content) in their isolated crystalline form; chemical composition exerts the greatest influence on the thermoluminescence from amino acids; the crystalline system to which an amino acid belongs seems to play only a minor or negligible role in determining the nature of the glow curves; and small changes in the level of purity may exert a relatively strong influence on the thermoluminescence from some amino acids. (auth)

57 TID-6640

Wisconsin. Univ., Madison.

GENETIC EFFECTS OF CUMULATIVE IRRADIATION IN RATS. Technical Progress Report. A. B. Chapman, N. E. Morton, and H. Vermund. Sept. 1, 1959. 4p. Contract AT(11-1)-697. OTS.

Results of preliminary experiments to establish total dose, system of fractionation of dose, and age at treatment

are given. Mortality, reproduction, and weight-for-age data indicate irradiation at 70, 84, and 98 days for a total dose of 450 r. Low fertility in the first generation of the main experiment necessitated some changes. (T.R.H.)

58 JPRS-2773(p.22-31)
THE STATE OF THE HIGHER NERVOUS ACTIVITY OF RATS SUBJECTED TO DAILY IRRADIATION WITH X-RAYS DURING THE PERIOD OF EMBRYONIC DEVELOPMENT. V. N. Semagin. Translated from Med. Radiol. 4, No. 6, 16-21(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16696.

59 JPRS-2773(p.32-40)
TEMPERATURE DISORDERS IN DOGS FROM MASSIVE IRRADIATION. N. A. Volokhova. Translated from Med. Radiol. 4, No. 6, 22-7(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16697.

60 JPRS-2773(p.41-8)
DISTURBANCES IN THE ADAPTIVE CHANGES OF THE BASAL METABOLISM OF RATS DURING X-IRRADIATION. A. Vatsek and G. Shmardovi (Shmardova). Translated from Med. Radiol. 4, No. 6, 27-32(1959).

A series of experiments was carried out to determine the effects of irradiation on the respiratory exchange in rats. A Czech remote analyzer recorded CO_2 excretion and O_2 consumption for 15 min, was interrupted for 2 hr, then was operated again during a 10-min irradiation to 50, 100, 200, 500, and 1,000 r. The results show that changes in the adaptive phase of respiratory exchange can be observed during irradiation. Results are reported and discussed. (T.R.H.)

61 JPRS-2773(p.57-62)
THE EFFECT OF IONIZING RADIATION ON THE BODY WITH THE CONSUMPTION OF DIFFERENT QUANTITIES OF HISTIDINE IN THE FOOD. A. E. Sharpenak, O. A. Shishova, and L. A. Gorozhankina. Translated from Med. Radiol. 4, No. 6, 37-41(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16700.

62 JPRS-2773(p.63-73)
X-RAY CHANGES OF THE GASTRO-INTESTINAL TRACT UNDER THE INFLUENCE OF ROENTGEN IRRADIATION OF PUPPIES OF DIFFERENT AGES. T. D. Mirimova. Translated from Med. Radiol. 4, No. 6, 41-7(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16701.

63 JPRS-2773(p.74-80)
THE PATHOGENESIS OF THE INCREASE IN ADENOSINE-TRIPHOSPHATASE ACTIVITY IN THE SPLEEN AFTER IRRADIATION OF THE HEAD OF RATS. E. (Ye.) A. Prokudina. Translated from Med. Radiol. 4, No. 6, 47-51 (1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16702.

64 JPRS-2773(p.81-7)
MORPHOLOGICAL CHANGES IN THE THYROID GLAND OF RATS OF DIFFERENT AGES AFTER A TOTAL-BODY X-IRRADIATION. E. (Ye.) A. Loskutova. Translated from Med. Radiol. 4, No. 6, 51-5(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16703.

65 JPRS-2773(p.94-105)
THE EFFECT OF IONIZING RADIATION ON PRESERVED BLOOD AND PLASMA. V. N. Vorob'ev (Vorobyev), Z. I. Sheremet, and M. O. Raushenbakh. Translated from Med. Radiol. 4, No. 6, 65-73(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16706.

66 JPRS-2773(p.110-13)
THE EFFECT OF Pu^{239} AND $Sr^{89,90}$ ON THE BONE MARROW OF THE WHITE RAT. S. R. Tsarapkin and Z. G. Sych. Translated from Med. Radiol. 4, No. 6, 75-7(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16708.

67
EFFECTS OF WHOLE-BODY ROENTGEN IRRADIATION ON THE NEUROSECRETORY MATERIAL OF THE RAT NEUROHYPOPHYSIS. V. K. Hopsu, S. Talanti, and A. Voutilainen (Helsinki Univ.). Acta Radiol. 54, 220-4 (1960) Sept. (In English)

Investigations showed that whole-body roentgen irradiations of 13 rats produced a decrease in the amount of neurosecretory material in eight of the animals. No corresponding changes were detected in the control group. The relation between this observation and the polyuria previously reported under similar experimental circumstances is discussed. (auth)

68
LOCALIZATION OF RADIOACTIVE PHOSPHORUS (P^{32}) IN THE BRAIN OF THE RAT AFTER IRRADIATION WITH X RAYS (20,000 r)—AUTORADIOGRAPHIC STUDY—PRELIMINARY WORK. M. Stajic, A. Dunjic, and Hio Hi Hou (Institut Neurologique Belge, Brussels). Ann. radiol. 2, R.585-90(1959). (In French)

With the aid of autoradiographs, the penetration of P^{32} in the nervous system was studied after irradiation with 20,000 r of the whole or part of the head of the rat. The P^{32} was injected parenterally 48 hr after the irradiation, and the animals were sacrificed 24 hr after this injection. The autoradiographs show that a larger amount of P^{32} passes into the cerebral tissue in comparison with the nonirradiated or protected cerebral tissue. (auth)

69
MEDICAL RADIOLOGY AND ARTIFICIAL MUTATIONS. Jérôme Lejeune (Centre National de la Recherche Scientifique, Paris). Ann. radiol. 2, R.889-902(1959). (In French)

A review is presented of published literature since 1956 with the object of outlining our knowledge of radiogenetics and surveying the information obtainable from studying the descendants of irradiated parents. After a consideration of artificial mutations in man, a brief description of natural mutations is given. (49 references). (T.R.H.)

70
THE PROBLEM OF INTERMEDIATE NUCLEOTIDE METABOLISM IN NORMAL AND X-RAY IRRADIATED BONE MARROW. G. A. Kritskii and V. A. Kopylov (A. N. Bakh Inst. of Biochemistry, Academy of Sciences, Moscow). Biochemistry (U.S.S.R.) (English Translation) 25, 24-9 (1960) Aug.-Sept.

In rabbit marrow were found adenylic, inosinic, guanylic, and uridylic acids, hypoxanthine, uracil, and other low-molecular-weight purine and pyrimidine substances. The content of these substances is sharply decreased in two days after local x-ray irradiation at a dose of 2000 r. Also found were traces of low-molecular-weight preformed deoxyribose compounds. Pyrophosphate is completely absent. This shows that the reaction of pyrophosphorolysis is practically absent in bone marrow under natural condi-

tions. The autolytic splitting of RNA preformed in bone marrow is two to three times faster in orthophosphate buffer solution than in pyrophosphate. This shows the possible presence of a reaction of orthophosphorolysis of RNA along with hydrolytic splitting of RNA. The enzymatic splitting of RNA preformed in bone marrow in ortho and pyrophosphate buffers two days after local irradiation at a dose of 2000 r is decreased two- to three-fold. The Barton method for determination of deoxyribose compounds was modified as follows: the solution to be analyzed is first brominated by the method of Massart and Hoste. This permits determination by the Barton method not only of purine deoxyribose compounds but also of pyrimidine deoxyribose compounds. (auth)

71

THE EFFECT OF IRRADIATION ON SOME STEPS IN THE OXIDATIVE TRANSFORMATION OF CARBOHYDRATES IN RAT LIVERS. G. A. Kochetov (Moscow State Univ.). Biochemistry (U.S.S.R.) (English Translation) 25, 52-6(1960) Aug.-Sept.

Total irradiation of rats with doses of 300, 600, 900, and 1200 r causes a decrease in dry weight of 1 g of liver and an increase in moist and dry weight of the organ as a whole. Quantitative dependence on dose was not observed. The activity of G-6-P and 6-PG1 dehydrogenases in the liver at doses of 600 r increased in one case and did not change in others. When the dose was increased, irradiation caused an increase in the number of animals which showed a change in activity of the enzyme, and at 1200 r the dehydrogenase activity was increased in all the animals. In the liver after irradiation with a dose of 600 r, the splitting of R-5-P and formation of S-7-P occurred faster; increase in fructose diphosphatase activity occurred; the hexose content in the tissues increased, and the process of its formation was considerably changed, both qualitatively and quantitatively (with R-5-P as substrate). (auth)

72

CONFIGURATIONS RESULTING FROM ISO-CHROMATID AND ISO-SUBCHROMATID UNIONS AFTER MEIOTIC AND MITOTIC PROPHASE IRRADIATION. G. B. Wilson and A. H. Sparrow (Brookhaven National Lab., Upton, N. Y.). Chromosoma 11, 229-44(1960). (In English)

Potential and actual configurations arising from presumed iso-chromatid and iso-subchromatid unions after irradiation of meiotic or mitotic prophase were studied and analyzed by making use of the chromosomes of Trillium erectum as a model. Diagrams and photographs of various recognizable types of chromatid or subchromatid rearrangements are presented. A minimum of two iso-chromatid unions within an arm of a single chromosome in meiotic prophase, if separated by a single chiasma, can give rise to a monocentric chromosome with a triplicated segment, the middle portion of which is an inversion. A minimum of two iso-subchromatid breaks within an arm at either meiotic or mitotic prophase also can result in the production of a monocentric chromosome containing a triplicated segment. The stage of appearance of dicentrics or bridges arising from chromatid or subchromatid unions in meiotic prophase is influenced by chiasma number and pattern and by the number of strands per chromosome or chromatid. Some of the rearrangements described may have genetic and evolutionary implication of considerable potential importance which has not been recognized previously. (auth)

73

X-RAY EFFECTS ON SINGLE NERVE FIBERS. C. S. Bachofer and M. E. Gautereaux (Univ. of Notre Dame, Ind.). J. Gen. Physiol. 42, 723-35(1959) Mar. 20.

Electrophysiological responses of median and lateral giant nerve fibers of the earthworm were recorded during exposure, in vitro, to x rays. In response to external stimulation, during x irradiation, these nerve fibers showed initially an increase in conduction velocity, a rise in spike amplitude, a decrease in relative refractory period, and an increase in sensitivity. These responses represent an enhancement of activity, attributable to bombardment with x rays, rarely found in other biological systems. They were followed by deterioration of activity and eventual block, representative of the lethal action of x rays, commonly observed in other biological systems. Several properties of the enhancement of activity were noted: The time at which maximum activity of one factor occurred did not coincide with the time at which the maxima of other activities occurred; spike amplitude, for example, was observed to increase, while conduction velocity had already reached its maximum and was rapidly declining. The energy supplied by bombardment with x rays did not act synergistically during the time of the enhanced response; i.e., concomitant irradiation was not necessary to produce the enhanced response, once the nerve had been altered by x irradiation. Once the nerve was responding in an enhanced manner, cessation of irradiation for short periods of time had no effect on the response. The phenomenon was therefore due to an irreversible alteration of the nerve fiber itself. (auth)

74

THE HEMOLYSIN RESPONSE IN RABBITS IMMUNIZED DURING LOW-LEVEL COBALT-60 GAMMA IRRADIATION. Laurence R. Draper (Argonne National Lab., Ill.). J. Infectious Diseases 107, 34-42(1960) July-Aug.

Eleven groups of rabbits were gamma irradiated at the rate of 11 r during 16 consecutive hours out of every 24 hr until they received from 77 to 1617 r during the course of 7 to 147 days. They were then injected with sheep red-blood-cell stromata and were kept under the same schedule of irradiation for 5 more weeks (385 r) while the hemolysin responses were studied. The hemolysin responses in these irradiated groups did not differ from those of the nonirradiated control group with respect to the mean length of the induction period, the mean rate of the first and most rapid rise of antibody, and the mean log peak titer; but, with increasing irradiation dose, peak titer tended to be reached later at a decreasing average rate. This shift was probably caused by a relative depression of early splenic hemolysin formation and by an increased and later production of hemolysin in one or more nonsplenic sites. (auth)

75

REPOPULATION OF THE SPLEEN OF X-IRRADIATED RABBITS BY TRITIUM-LABELED LYMPHOID CELLS OF THE SHIELDED APPENDIX. Dieter H. Süssdorf (Argonne National Lab., Ill.). J. Infectious Diseases 107, 108-14 (1960) July-Aug.

Appendix-shielded and nonshielded rabbits received 500 r x-ray exposure to the body and were injected with tritium-labeled thymidine 17 hr later. Radioautographic analysis of organ impression preparations revealed that, in the appendix-shielded rabbits, 20.2% of the lymphoid cells of the appendix were labeled at 3 hr after thymidine injection. Labeled cells did not appear in the spleen until 28 hr later. While the percentage of labeled cells increased in the spleen, a concurrent temporary decrease was ob-

served in the appendix. Only a moderate rise in the percentage of labeled cells was found in the appendix and spleen of the totally irradiated animals. The results lend support to the hypothesis that the rapid recovery of the splenic white pulp in x-irradiated, appendix-shielded rabbits is due to the repopulation of the spleen by cells of the appendix. (auth)

76

PROBLEMS OF METHODOLOGY, PLANNING AND COORDINATION. THE ROLE OF PENETRATING RADIATION IN TUMOUR DEVELOPMENT. N. N. Litvinov. Problems of Oncol. (U.S.S.R.) (English Translation) 6, 155-63(1960) Sept.

A review is presented of the literature on the development of radiation tumors in various organs and tissues in various animal species following exposure to external and internal irradiation. 104 references. (C.H.)

77

AMINO ACID SUPPRESSION OF RADIATION-INDUCED TUMORIZATION OF FERN PROTHALLI. Carl R. Partanen (Children's Hospital Medical Center, Boston). Proc. Natl. Acad. Sci. U. S. 46, 1206-10(1960) Sept.

The frequency of tumors induced in prothalli of Pteridium aquilinum by x irradiation of dormant spores prior to germination can be influenced by the incorporation of certain amino acids into the medium upon which they are grown. Many of the components of casein hydrolysate reduce the frequency to varying degrees, notably methionine and lysine. The effect of lysine can be nullified by the addition of equimolar concentrations of arginine. Other amino acids (e.g., glutamic acid) may instead enhance the tumor frequency. Some possible implications of these observations are discussed. (auth)

78

DIVERSE RATIOS OF MUTATIONS TO CHROMOSOME ABERRATIONS IN BARLEY TREATED WITH DIETHYL SULFATE AND GAMMA RAYS. R. E. Heiner, C. F. Konzak, R. A. Nilan, and R. R. Legault (Washington State Univ., Pullman). Proc. Natl. Acad. Sci. U. S. 46, 1215-21 (1960) Sept.

Treatment with a diethyl sulfate solution caused injury to barley seeds, but the injury differed from that caused by radiation in that the characteristic leaf flecking of M_1 seedlings was not observed. The relative absence of leaf flecking appeared to be correlated with the observed low frequency of chromosome structural changes at the first mitosis in treated seeds and microsporocytes of M_1 plants. In contrast, radiation treatments produced abundant chromosome structural damage which could be measured at both stages of plant growth. The semisterility of M_1 spikes of diethyl-sulfate-treated barley could not be accounted for on the basis of induced chromosome interchanges. It was found that diethyl sulfate treatments induced a high frequency of mutations, and further investigation revealed that the spectrum of mutation types appeared to be different for the two mutagenic agents being compared. The distinct lack of association of chromosome structural aberrations with mutations for a highly effective mutagenic agent has broad fundamental as well as practical implications. (auth)

79

A PROSPECTIVE STUDY OF THE LEUKAEMIA MORTALITY OF CHILDREN EXPOSED TO ANTE-NATAL DIAGNOSTIC RADIOGRAPHY. A PRELIMINARY REPORT [SUMMARY]. W. M. Court Brown (Medical Research Council, Edinburgh) and Richard Doll. Proc. Roy. Soc. Med. 53, 761-2(1960) Sept.

A survey was made of the mortality from leukemia of children exposed in utero to diagnostic x rays. It was concluded that if a leukemogenic risk is incurred by prenatal x-ray exposure, the risk is very small. (C.H.)

80

IN VIVO OBSERVATIONS OF THE SMALL MESENTERIC VESSELS DURING PROTRACTED GAMMA IRRADIATION. G. F. Mazzoleni, A. de Silvestri, and C. Piovella (Università, Pavia, Italy). Radiol. med. 46, 649-53(1960) July. (In Italian)

Microscopic observation of the mesenteric vascular network of the frog during γ irradiation did not reveal any notable modifications of the circulatory dynamics. It is only after six hours or more of irradiation that a decrease of the arterio-venous caliber by a third with return of endo and perivascular leucocytes is observed. The irradiation of a mesenteric loop permits the observation, in a selective manner, of the vascular modifications without the parenchymous organs being simultaneously affected. (tr-auth)

81

REACTIONS OF THE ADRENAL CORTEX TO LOW-DOSAGE INTERNAL IONIZING RADIATION. V. I. Kandror (Lab. of Radiobiology, Hygiene Research Inst., Moscow). Sechenov Physiol. J. (U.S.S.R.) (English Translation) 46, 268-75(1960) Aug.

Na^{24} injected into rats in concentrations of 500 μc/250 g and 50 μc/250 g led to involution of the thymus gland, increase in the weight of the suprarenals, and initial reduction of their contents of ascorbic acid and lipids. The functioning of the adrenal cortex became normal again 15 to 25 days after injection of the isotope. A Na^{24} concentration of 5 μc/250 g did not produce any statistically valid change in the weight of the thymus, in the weight of the suprarenals, or in their content of ascorbic acid. Changes in adrenocortical function are early and highly sensitive indices of the effect of ionizing radiation on the body. (auth)

82

THE OCCURRENCE AND SIGNIFICANCE OF BINUCLEATE LYMPHOCYTES IN PERIPHERAL BLOOD AFTER SMALL RADIATION EXPOSURES. M. Ingram (Univ. of Rochester, Atomic Energy Project, N. Y.). p.233-45 of "Immediate and Low Level Effects of Ionizing Radiations, Conference held in Venice, June 1959."

Increased numbers of binucleate lymphocytes can be observed in peripheral blood following radiation exposures in the maximum permissible exposure range. The phenomenon is potentially valuable as a biological indicator of exposure. Its value in this respect would be enhanced if other distinctive biological indicators could be found for simultaneous use as a diagnostic panel for screening instances of suspected exposure. The prognostic significance of increased numbers of binucleate lymphocytes is a challenging problem for which no satisfactory answer is presently available. Attention was called to the possibility that the phenomenon may have some prognostic significance with respect to late and latent effects of radiation, especially leukomogenesis. Further studies of the cytological abnormality in binucleate lymphocytes are indicated. (auth)

83

Co^{60}-IRRADIATOR AND ITS USE FOR PLANT GENETICS. S. Matsumura, T. Fujii, and S. Kondo. p.179-93 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

A facility for Co^{60} gamma ray irradiation was built in 1956. The gamma irradiation room and the emitter were specially designed to give a fairly wide range irradiation over a horizontal plane for the investigation of induced mu-

tations and other radiobiological effects upon plants and animals. The emitter consists mainly of an irradiator head and a remote controller. The former has the maximum capacity to contain Co^{60} of 100 curies and the latter serves for remote control of the vertical position of the irradiator head. The lead filters were designed to produce three regions of roughly constant but different dose rates. For simplicity's sake, in the design only primary radiation was considered. The best estimate of the effective source strength, determined with Fricke's ferrous sulfate chemical dosimeter and a Victoreen ion chamber, was 31.3 curies as of Nov. 1, 1957. Radiosensitivity was found to be quite different between different plant species. Comparative studies of radiosensitivity in various kinds of plants, especially related plants of various polyploid series, were carried out from 1956 through 1958. Dry dormant seeds were exposed to gamma rays at dose range of 10 to 100 kr, and radiosensitivity was examined from decrease in germination and/or survival rates. Radiosensitivity must be determined by the percentage of seedlings which had developed two or three leaves. Differences of sensitivity between di-, tetra-, and hexaploid plants were compared in several species and varieties of Triticum and Aegilops. These results show that radiosensitivity depends not only on polyploidy but on the kind and number of genomes. In vegetatively propagating plants use of radiation to obtain induced bud or somatic mutations is one of the most promising methods for plant breeding. For any case, the number of successfully planted ones and that of their sprouts, per plant, decreased with increasing radiation dosage. X rays were more effective in this respect than gamma rays. The number of plants with radiation-induced abnormal leaves or flowers increased roughly with increasing dosage and the rate of somatic mutation and chimera. Some of those results are promising for plant breeding. (auth)

84

USES OF LARGE SOURCES OF IONIZING RADIATION IN BOTANICAL RESEARCH AND SOME POSSIBLE PRACTICAL APPLICATIONS. Arnold H. Sparrow (Brookhaven National Lab., Upton, N. Y.). p.195-219 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

Co^{60} gamma sources varying in size from 0.2 to about 2200 curies were used to study the effects of acute and chronic gamma irradiation on plants or parts of plants. Special facilities described include a large outdoor gamma field (about 10 acres) using sources up to 2200 curies and indoor greenhouse facilities using up to 14 curies. Both acute and chronic exposures can be used experimentally in many ways in basic botanical research and certain effects are, or promise to be, of some practical value. Effects described include (1) cytogenetic effects and the use of induced mutations in plant improvement; (2) inhibition of sprouting of vegetables; (3) dwarfing by irradiation of plants or antecedent seeds, and bulbs; (4) killing of pests or parasites; (5) selective weeding by killing or pollen sterilization; (6) sterilization or pasteurization of soil or other propagating media; (7) surface sterilization of plants, plant parts, or plant products (with beta rays); (8) food preservation by cold sterilization; (9) breaking of dormancy; (10) enhanced or stimulated growth; (11) early flowering; (12) induction of roots on stems; (13) delay of ripening of fruit and certain vegetables. In addition, some results of research on several aspects related to basic radiobiological problems are given. These include studies on (1) differences in radiosensitivities of different plant species; (2) probable ecological consequences of chronic exposure above background levels; (3) radiation-induced tumors in several species; and (4) the study of patterns of growth by means of induced mutant tissue. It thus seems clear that ionizing radiation is a valuable research tool in many aspects of plant science and will become progressively more important in several areas of plant industry. Rapid expansion in both fundamental research and the development of practical applications of large radiation sources seem assured. (auth)

85

THE EFFECT OF ACUTE, CHRONIC AND FRACTIONATED DOSES OF GAMMA RADIATION ON THE INDUCTION OF SOMATIC MUTATIONS IN TRIFOLIUM REPENS. D. R. Davies and E. T. Wall (Wantage Radiation Lab., Berks, Eng.). p.221-37 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

Clonal lines of Trifolium repens heterozygous for the V^{by} leaf marking allele were exposed to acute and chronic gamma irradiation from a Co^{60} source. Mutations resulting both in the loss of all or part of the leaf mark, and in the production of other forms of mark were observed. The dose-response curve for the induction of these mutations appeared linear. Fractionation of the dose, or exposure to chronic irradiation, resulted in considerable reduction in the induced mutation frequency. Mutant tillers ultimately appeared on several plants and progeny tests of these are planned, to test the nature of the genetic changes. (auth)

86

THE USE OF GAMMA RAY SOURCES FOR THE INACTIVATION OF VIRUSES. E. C. Pollard and W. R. Guild (Yale Univ., New Haven). p.239-48 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

The inactivation of viruses serves two main purposes. The first is the removal of the infectivity from foodstuffs or drugs in which it would be considered harmful. The second is in the formation of killed vaccines which retain their antigenicity while having lost their infective property. The problem of the removal of virus activity by ionizing radiation is one which can be rather straightforwardly described. Ionizing radiation, in general, produces exponential inactivation of viruses with occasionally a second component which is usually not very different in slope from the first. The degree of inactivation of plant, animal, or bacterial virus can be confidently predicted after irradiation by a source such as a Co^{60} gamma source. The inactivation curves for a whole series of plant, animal, and bacterial viruses are given and the intensities of sources necessary for producing varying degrees of inactivation are proposed. The effect of combined thermal and ionizing radiation is of interest, and a description of experiments showing the effect of these two are included. The problem of making vaccines is of great interest inasmuch as existing methods of inactivating polio virus by formalin seem to have run into a great many troubles in the actual processing. It is quite likely that a technique which used moderate thermal elevations together with gamma ray inactivation would yield virus which was antigenically quite potent while at the same time not infectious. The rationale behind this approach is discussed and one or two preliminary experiments described. (auth)

87

INSECT ERADICATION BY RELEASE OF STERILIZED MALES. R. C. Bushland (Agricultural Research Service, Kerrville, Tex.). p.273-90 of "Large Radiation Sources in

Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

Doses of gamma radiation at 5,000 to 10,000 r, given to insects either as adults or well-developed pupae, are tolerated by somatic tissues but produce dominant lethal mutations in the germ cells, thus sterilizing the insects. Male screw-worm flies, irradiated as pupae, compete for mates when released in nature. Female screw-worms mate only once, so those mated to sterile males cannot reproduce. In nature screw-worm flies number at most only a few hundred per square mile because they breed only in wounds in living animals. Hence, they can be outnumbered by sterilized flies reared in the laboratory on ground meat and blood. When the native population is outnumbered by sterile insects, the majority of the native females make sterile matings. This reduction in biotic potential causes a decline in numbers of each new generation. By maintaining a constant high population of released sterile insects, the native population is overwhelmed in a few generations. Following these principles, screw-worms were eradicated from the Island of Curacao by 4 months of release in 1954. An eradication program is now under way in the Southeastern United States. Releases were started early in 1958 and the results were so effective that no native screw-worms were found after Feb. 19, 1959. The success with screw-worms has stimulated research to apply the sterilized male technique to the eradication of other insects. Research is being done with various species of fruit flies. The method may have application to the control of other insects which are subject to having their populations so reduced by insecticidal or cultural procedures that they can be outnumbered by sterilized males. (auth)

88

SUSCEPTIBILITY OF THE GRAIN AND RICE WEEVILS, CALANDRA GRANARIA L. AND C. ORYZAE L. TO GAMMA RADIATION. P. B. Cornwell and J. A. Morris (Wantage Radiation Lab., Berks, Eng.). p.291-9 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

A contribution is given to present knowledge of the entomology of radiation treatment of grain. An examination is made of the effects of gamma radiation on the two principal grain pests, when these are reared and retained under near optimum conditions for the species. The effects of radiation on the complete life-history of a laboratory strain (ex Pest Infestation Laboratory, D.S.I.R.), of the grain weevil, C. granaria, were examined at 24-hourly intervals during the life history. Each stage of development was subjected to 17 doses at 250 to 20,000 rep. Three criteria were used to determine radiation susceptibility: (1) emergence of immature stages as adults from grain, (2) survival after emergence, and (3) the production of adult progeny. Similar observations on all stages of the rice weevil, C. oryzae, allow a comparison of susceptibility in the two species. Additional studies with C. granaria include: (1) radiation susceptibility of the sexes and (2) periodicity in fertility at sub-sterilizing doses. Doses evaluated for commercial disinfestation are tested against massive populations and under a limited range of commercial storage conditions. The relative merits of fumigation treatment and radiation desinfectation are compared. (auth)

Radiation Sickness

89 TID-6743

Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.

RATE OF RECOVERY FROM RADIATION INJURY AND ITS RELATIONSHIP TO AFTER EXPECTATION OF LIFE IN MICE. Progress Report [for] January 1, 1960–September 20, 1960. Renewal period: January 1, 1961–December 31, 1961. John B. Storer. Sept. 20, 1960. 16p. Contract AT(30-1)-2313. OTS.

About 4500 RF female mice were irradiated at 0 or 400 r at 90 days of age and sampled at later ages for LD_{50}, repair rate (split-dose method), and mean after-survival under daily exposure to 100 r. Details of results are given. About 6000 BDF hybrid females were exposed to 0, 100, 300, or 500 r at 90 days. Because of the long life span of this hybrid no sampling points have been reached. (T.R.H.)

90 JPRS-2773(p.49-56)

THE COURSE OF RADIATION SICKNESS IN DOGS WITH EXTIRPATED LYMPHOID ORGANS. Yu. M. Zaretskaya. Translated from Med. Radiol. 4, No. 6, 32-7(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16699.

91 JPRS-2773(p.88-93)

THE EFFECT OF THE ADRENOCORTICOTROPIC HORMONE AND CORTISONE ON THE COURSE AND OUTCOME OF RADIATION SICKNESS IN WHITE RATS OF DIFFERENT AGES. M. V. Propp. Translated from Med. Radiol. 4, No. 6, 61-4(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 16705.

92 JPRS-2773(p.121-5)

EXCHANGE BLOOD TRANSFUSION IN RADIATION SICKNESS. (An Experimental Study). D. S. Kuz'min. Translated from Med. Radiol. 4, No. 6, 82-4(1959).

The effectiveness of blood replacement in therapy of radiation sickness was studied in 23 dogs with 17 additional control dogs. Clinical observations were made and the animals were then irradiated in a twin RUM-3 apparatus at 10 to 11.5 r/min to a total of 500 r. Simultaneous exfusion and transfusion were used in some experiments and a Beck direct transfusion apparatus was used in the rest. It was concluded from the results that blood replacement in radiation sickness is of indubitable efficiency and its use is recommended in combination with other measures. (T.R.H.)

93 JPRS-2773(p.135-6)

THE UPPER OXYGEN LIMIT OF THE AFTER-EFFECT REACTION IN RADIATION INJURY. K. D. Kalantarov. Translated from Med. Radiol. 4, No. 6, 89(1959).

The oxygen effect during incubation of irradiated yeast was studied. After 200,000 r the yeasts were incubated for 20 hr at different O_2 pressures. The injury increases first at 100 to 200 mm O_2 pressure, then decreases as pressure continues to increase. Injury again increases as pressure is increased near 500 mm, then decreases near 600 mm of mercury. Thus, O_2 does participate in the after-effect reactions. (T.R.H.)

94

PROBLEMS BROUGHT UP BY RESTORING INJECTIONS OF HEMOPOIETIC CELLS IN ANIMALS IRRADIATED IN TOTO. POSSIBLE CLINICAL APPLICATIONS. J. F. Duplan (Institut du Radium, Paris). Ann. radiol. 2, R.99-106(1960). (In French)

A series of experiments performed over a period of 8 years has shown the possibility of grafting hemopoietic cells from isologous, homologous, or heterologous donors to an irradiated animal. Homologous or heterologous transplants can be performed only if the receiver was given at least a 75% lethal dose of x rays, whereas isologous transfers are possible even for infralethal doses. These implants are regulated by the immunogenetic laws

and by immunology applied to radiobiology. The first effect of these cell injections is to produce a rapid regeneration of blood cells since the hemopoietic bodies are restocked by the donor's cells. Mortality due to medullary aplasia disappears or diminishes. When the injected cells are provided by homologous or heterologous donors, the receivers tolerate the skin grafts isologous to the donor's cells and hence homologous and heterologous to the receiver. This therapy by cellular substitution completely inhibits radiolymphoid leukemogenesis in the mouse but does not modify the frequency of other radiocarcinoma. It is possible by homologous cell implants to anticipate appearance of lymphoid leukemia in the mouse but not to cure evolving leucosis. At this time the applications of this technique in human therapy are very limited. The few attempts made to treat acute leucosis or to obtain renal grafts ended in failures which were foreseen by experimentation. It would seem very untimely, as long as new experimental knowledge is not obtained, to wish to apply this method to man, apart from treatment of massive accidental irradiation. (auth)

95

A COMPARISON OF THE RESTORATIVE EFFICACY OF BONE MARROW AND FETAL LIVER INJECTED INTO MICE IRRADIATED IN TOTO BY X RAYS. Gino Doria and Jean-François Duplan (Institut du Radium, Paris). Ann. radiol. 2, R.443-6(1959). (In French)

A comparative study of the restorative efficacy of cellular suspensions of fetal liver and bone marrow was carried out on mice irradiated with a 100% lethal dose of x rays. When givers and receivers both belong to the same pure strain and when the number of cells injected is not more than 1.5×10^7 cellular suspensions prepared with 17-day-old fetal livers have a greater restorative activity than those prepared with 13-day-old or 19-day-old livers. To obtain the same survival rate, the number of fetal cells of 15, 16, or 17 days that is required is at least twice and probably three times as great as the number of myeloid cells taken from adult mice; this is true whether the restoration is homologous or isologous. (auth)

CHEMISTRY

General and Miscellaneous

96 CNC-43

Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.

ESISTENZA DI FORME ASSOCIATE IN SOLUZIONI BENZENICHE DI NITRATO DI TRI-N-OTTILAMMINA. CONTRIBUTO ALLA CONOSCENZA DELLE SUE PROPRIETÀ ESTRATTIVE NEI CONFRONTI DELL'ACIDO NITRICO. (On the Existence of Aggregates in Benzene Solutions of Tri-n-Octylamine Nitrate. Contribution to the Knowledge of their Extraction Properties with Reference to the Nitric Acid). G. Scibona. July 1960. 19p.

Benzene solutions of tri-n-octylamine and tri-n-octylamine nitrate have been examined for the presence of aggregates. Light scattering and polarization measurements have given sufficient evidence for the existence of aggregates (average degree of association 60) in benzene solution of tri-n-octylamine nitrate. No aggregation was shown by the free amine solutions. A consistent picture of the nitric acid extraction by tri-n-octylamine nitrate in benzene is given on the basis of the amphiphilic compound's behavior. (auth)

97 HW-63824(p.50-4)

General Electric Co. Hanford Atomic Products Operation, Richland.

PROTOLYSIS AND HYDROLYSIS REACTIONS OF ERIOGLAUCINE IN AQUEOUS SOLUTIONS. D. R. Kalkwarf and R. W. Henkens.

Erioglaucine has been used as a reference compound for comparing the relative rates at which free radicals react with various solutes in neutral aqueous solution. In order to extend this comparison to non-neutral, aqueous solutions and to determine which structural form of this dye is the most efficient free-radical scavenger, experiments were performed to determine these forms in solution and the rate expressions and equilibrium constants for their protolysis and hydrolysis reactions. Data are presented graphically. (auth)

98 HW-65478

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

HIGH FLOW RATE OPERATION OF A DUPLEX ION EXCHANGE SYSTEM. T. F. Demmitt. June 2, 1960. 31p. Contract AT(45-1)-1350. OTS.

Tests were performed to evaluate the operating characteristics of a duplex deionization system under high flow rate conditions. Duplex systems (cation exchanger followed by an anion exchanger) were tested at flow rates of 10, 25, 50, and 75 gpm per sq ft of cross-sectional area. System-operating lifetimes of 21.5, 8.5, 4.0, and 2.2 hr, respectively, were obtained at these conditions using 4-ft-deep resin beds. The average effluent specific resistance ranged between 4×10^5 and 8×10^5 ohm-cm during these tests. In every case, anion leakage (predominantly silica) indicated the initial breakthrough. (auth)

99 NP-9220

Monsanto Chemical Co., Everett, Mass.

RESEARCH ON SYNTHESIS OF 1000°F STABLE BASE FLUIDS. Quarterly Progress Report [for] May 1, 1960 to July 31, 1960. J. W. Dale, G. J. O'Neill, P. G. Scheurer, and G. R. Wilson. Aug. 15, 1960. 22p. Project 0(3-8128). Contract AF33(616)-6851.

Research on thermally stable fluids is reported in which production of polymeric perfluoroaromatic derivatives is the ultimate aim. Certain nonfluorine-containing compounds are also being investigated. Fluorination of 1,2-diphenoxyethane using CoF_3 is reported. Other stepwise syntheses are being investigated; however, these are not far enough advanced to evaluate. The most stable nonfluorine compounds evaluated up to this point include benzophenone, m-dibenzoylbenzene, and fluorenone. (For preceding period see NP-876.) (J.R.D.)

100 NP-9246

Columbia Univ., New York. Stanley Thompson Labs. and Columbia Univ., New York. School of Mines.

EFFECT OF ADSORBED FILMS ON THE SURFACE POTENTIALS OF METALS BY A RADIOACTIVE ELECTRODE TECHNIQUE. Leonard Nanis, Marianne Baruch, and Jack H. Schulman. June 1, 1960. 28p. Contract NONR-266(64).

The effects of adsorbed organic materials on the surface potentials of gold, silver, and platinum were investigated by using a radioactive electrode technique. (C.J.G.)

101 NYO-2522

Radiation Applications Inc., Long Island City, N. Y.

FOAM SEPARATION IN ISOTOPE RECOVERY. Quarterly Report for the Period July 1 to October 1, 1960. [R. A. Sanford]. Oct. 10, 1960. 27p. Contract AT(30-1)-2384. OTS.

A screening program of potential complexing surface-active agents for metal-ion recovery by foam separation was initiated. The program required selection of the physicochemical characteristics to be tested, selection of

the most suitable testing techniques, standardization of the techniques, and application of the techniques in a mass-screening method. Approximately 30 surface-active agents were tested for solubility, CMC determination by conductivity, foamability, and cesium enrichment. Competing effects in the system strontium-DBDTTA (dodecylbenzyl diethylenetriamine tetraacetic acid) were studied in a continuous-recycle batch-foam system. The objective was to determine: (a) whether there is competition between micelle formation and surface adsorption for the metal chelate, and (b) whether there is competition for surface positions between the complexed and the noncomplexed forms of the surface-active agent DBDTTA. The results strongly support both competing effects. A systematic reference file of surface-active agents was set up during the period. (auth)

102 TID-3904
Michigan State Univ., East Lansing.
SELECTED BIBLIOGRAPHY OF PHYSICO-CHEMICAL PROPERTIES IN LIQUID AMMONIA AND RELATED SOLVENTS. R. F. Sankuer and J. L. Dye. Oct. 1, 1959. 98p. Contract AT(11-1)-312. OTS.

This bibliography contains 716 references to theses and published literature on solvents. The references are taken primarily from Chemical Abstracts. (J.R.D.)

103 TID-6429
Michigan Chemical Corp., St. Louis, Mich.
RECOVERY OF COPPER, VERSENE, AND WATER FROM RARE EARTH PLANT EFFLUENT. Report 1 [for] Period September 4, 1956 through March 11, 1957. Report 72. John R. Morton. Mar. 13, 1957. Decl. Feb. 6, 1959. 21p. OTS.

Studies were made on separating copper and versene (ethylenediaminetetraacetic acid) from copper versenate solution by H_2S and $(NH_4)_2S$ processes. The $(NH_4)_2S$ process was the most satisfactory owing to simplicity of operation and lower cost. (C.J.G.)

104 TID-6470
Oak Ridge Gaseous Diffusion Plant, Tenn.
AN IMPROVED LABORATORY COLD-TRAP AND PROCEDURE FOR REDUCING PERSONNEL HAZARD. T. G Burke. Sept. 26, 1958. Revised July 15, 1960. 6p. (KL-237(Rev.)). OTS.

The design of a cold trap for laboratory use is described Associated shielding and operating procedures to provide personnel protection and efficient performance in daily operation are described. (J.R.D.)

105 TID-6586
Iowa State Univ. of Science and Technology, Ames.
[SYNTHESIS OF ORGANIC COMPOUNDS] Final Report. Henry Gilman. [1959?]. 19p. Project No. 7. Contract AT(11-1)-59. OTS.

A list is given of 285 organic compounds prepared as candidate compounds for use as primary scintillation solutes. Their GAEC code numbers and relative pulse-height values also are given. A list of 15 organo-boron compounds synthesized for work in neutron-capture therapy relative to brain tumor studies is included. (M.C.G.)

106 CEA-tr-R-864
ECHANGE DE DEUTERIUM ENTRE LE DBr LIQUIDE ET LES ALCANES RENFERMANT LE GROUPEMENT PHENYL. (Exchange of Deuterium between Liquid DBr and Alkanes Bound to the Phenyl Group). A. I. Shatenshtein (Shatenstein), V. P. Kalinachenko, E. N. Yurigina (Iuriguina), and V. M. Basmanova. Translated into French from Zhur. Obshchei Khim. 29, 849-55(1959). 16p.

An investigation was made of deuterium exchange between liquid DBr and diphenylmethane, triphenylmethane, tetraphenylmethane, fluorene, dibenzyl, symtetraphenylethane, 1,1,1-triphenylethane, 1,3-diphenylpropane, 1,4-diphenylbutane, and 1,5-diphenylpentane. It was found that the phenyl rings separated by a carbon atom (as in tetraphenylmethane) exert an influence on the reciprocal reactivity. The effect of conjugation and of chemical activity of the aromatic ring was established. A relation between the chemical activity of 15 aromatic rings of phenylalkanes and the number of aliphatic CH bonds (α and β) and phenyl groups was found. An explanation was offered. (tr-auth)

107 UCRL-Trans-569(L)
THE CHROMATOGRAPHY OF ALIPHATIC ISOMERS. I. THE RELATIONSHIP BETWEEN THE DIPOLE MOMENT AND THE R_F VALUE OF BENZENE DERIVATIVES. Jaroslav Franc and Josef Latinák. Translated from Chem. listy 49, 317-24(1955). 17p. (includes original, 9p.). JCL.

The relations between the chromatographic behavior of aromatic benzene isomers and the magnitude of their dipole moments were studied. It was found that with an anchored polar phase the dipole moment is related directly to the R_F value as expressed by the equation $R_F = K - 0.1\ \mu$. (J.R.D.)

108
ON THE SPATIAL CONSTRUCTION OF β-DIKETONE-COMPLEXES OF TETRAVALENT CATIONS WITH THE COORDINATION NUMBER 8. THE CRYSTAL STRUCTURE OF CERIUM–TETRAKIS–(DIBENZOYLMETHANE). Leopold Wolf and Hartmut Bärnighausen (Karl-Marx-Universität, Leipzig). Acta Cryst. 13, 778-85(1960) Oct. 10. (In German)

As a step toward the structure determination of the thorium, cerium, and uranium tetrakis-dibenzoylmethanes, the [001] and [100] electron-density projections of the Ce complex were determined. The signs of the F's were determined by the isomorphous-replacement method from Weissenberg photographs of spherical crystals. The ambiguity in the heavy-atom z parameters, found by trial and error, was resolved by spatial considerations; and a structure is proposed. The idealized structure shows an eight-fold coordination of the quadrivalent heavy atom by oxygen, the symmetry of the arrangement being bis-disphenoidal ($\bar{4}2m$). (auth)

109
POLAROGRAPHIC STUDIES ON THE RARE EARTHS. III. YTTRIUM. Seizo Misumi and Yasushi Ide (Kyushu Univ., Fukuoka, Japan). Bull. Chem. Soc. Japan 33, 836-41(1960) June.

The reduction wave of the aquo tripositive yttrium complex ion was studied in an unbuffered solution under various conditions for the purpose of solving the electrode reaction in the reduction process. The results of this investigation differed from previously reported findings. The addition of dilute acid to prevent hydrolysis of the complex ion resulted in a complete separation of the hydrogen wave from the reduction wave of the complex ion. The reduction wave was generally a single wave in a perchlorate solution and often a double wave in a halide solution. The electrode reaction of the single wave was irreversible and of a three-electron reduction. For the double wave, the first wave was irreversible or quasi-reversible and its electrode reaction was of a three-electron reduction; the second wave was irreversible and anomalous. (B.O.G.)

110
COMPLEX COMPOUNDS OF ALUMINIUM WITH MANDELIC ACID. S. N. Srivastava and Manohar (St. Johns'

Coll., Agra, India). J. Indian Chem. Soc. 37, 299-302(1960) May. (In English)

From pH and conductance measurements it is concluded that mandelic acid is a good chelating agent for aluminum. Three chelates corresponding to 1:1, 1:2, and 1:3 formulas are formed. The chelate of composition 1:1 is formed at a lower pH value, while 1:2 and 1:3 chelates, which occur at pH 6.5 and 7.8, respectively, are more stable than 1:1 chelate. The chelation takes place easily on account of the close proximity of the acidic and electron-ionating groups, a fact which is essential for formation of the ring containing the metal atom. (auth)

111

THE APPLICATION OF RADIOACTIVE ISOTOPES TO RESEARCH AND CONTROL OF CHEMICAL TECHNOLOGY PROCESSES. G. P. Miklykhin (Miklukhin) and A. F. Rekasheva (Riekaszewa). Nowa Tech. No. 2, 40p.(1956). (In Polish)

A comprehensive review is presented of a variety of chemical technology, product control, reaction mechanism, and process-direction problems resolved through the use of radioisotopes, e.g., molecular structure determination by substituting deuterons for ordinary hydrogen in organic reactions. 184 references. (TTT)

112

ISOTOPES IN CATALYSIS. S. Z. Rogiński. Nowa Tech. No. 5, 7-38(1959). (In Polish)

The reported developments in the application of tracer isotopes to the study and control of catalysis are organized and presented to give a brief survey of the capabilities of isotopic methods in investigating catalytic processes. A discussion of the theory of catalysis treats the surface phenomena of solid catalysts and methods of determining the properties of both heterogeneous and homogeneous surfaces. The genesis and microchemistry of catalysts follows. Isotopic exchange is discussed first as a model of a type of catalytic reaction and subsequently as a tool for investigating catalytic processes in the following areas: genetic relations of substances taking part in reactions; definition of the stage of reaction regulating the process; the intermediary transitory state in catalysis; investigation of the state of a chemi-absorbed particle by catalysis with isotopic exchange; and multiple exchange in catalytic reactions. The mutual relationship of isotopic chemistry and catalysis is treated, with emphasis on the need of applying both to obtain a broader fundamental knowledge of catalytic processes and of isotopic chemistry. 127 references. (TTT)

113

RADIOCHEMICAL INVESTIGATION OF ION EXCHANGE ON SWELLED EXCHANGERS. A. M. Trofimov and L. N. Stepanova (Khlonino Radium Inst., Academy of Sciences, USSR). Zhur. Fiz. Khim. 34, 1837-42(1960) Aug. (In Russian)

The correlations of the exchange of ions of various valences on swelled ion exchangers were investigated by a radiochemical method. A relation was established between the distribution coefficient of the ions of the radioelement, the specific capacity of the exchanger, and the specific volume of the latter. This is expressed by the following equation:

$$\frac{\alpha V^{(z_1-z_2)/z_2}}{g^{z_1/z_2}} = \text{const}$$

(z_1 and z_2 are the valences of the exchanging ions). On the basis of this equation, with the aid of two resin specimens of the same specific capacity and greatly different swelling powers the magnitude of the charge of the radioelement in solution can be determined. (auth)

114

SPECTROPHOTOMETRIC STUDY OF URANYL COMPLEX FORMATION WITH ETHYLENEDIAMINETETRAACETIC ACID. A. G. Kozlov and N. N. Krot. Zhur. Neorg. Khim. 5, 1959-63(1960) Sept. (In Russian)

Spectrophotometric studies were made of uranyl ion complexing by ethylenediaminetetraacetic acid (EDTA). The compounds UO_2H_2Y, $(UO_2)_2Y$, and $(UO_2Y)^{2-}$ were found and separated. The instability constants of $(UO_2)_2Y$ and $(UO_2Y)^{2-}$ were calculated. (R.V.J.)

115

THE INFLUENCE OF SOLVENT ON STABILITY OF TITANIUM, ZIRCONIUM, AND HAFNIUM WITH PHOSPHORYL CHLORIDES. B. A. Voĭtovich (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zhur. Neorg. Khim. 5, 1981-6(1960) Sept. (In Russian)

Molecular compounds with the general formula $MeCl \cdot POCl_3$ and $MeCl_4 \cdot 2POCl_3$ were found in binary systems of titanium, zirconium, and hafnium chlorides with phosphorus oxychloride. The stability of the compounds increases from titanium to hafnium. The influence of the solvent on the stability of the compounds was studied using nitrobenzene solutions. The stability in solution varies in the same sequence as the individual states. (R.V.J.)

116

FORMATION OF THE THIRD PHASE IN $UO_2(NO_3)_2-HNO_3-H_2O-$TRI-H-BUTYLPHOSPHATE–"KEROSENE." A. S. Solovkin, N. S. Povitskiĭ, and K. P. Lunichkina. Zhur. Neorg. Khim. 5, 2115-18(1960) Sept. (In Russian)

The conditions of the third phase in a $UO_2(NO_3)_2-HNO_3-H_2O-$TBP–kerosene system are analyzed. It is shown that $H[UO_2(NO_3)_3] \cdot 2TBP$ is the third phase compound. (R.V.J.)

117

FUEL CELLS. A Symposium held by the Gas and Fuel Division of the American Chemical Society at the 136th National Meeting in Atlantic City. G. J. Young, ed. New York, Reinhold Publishing Corporation and London, Chapman & Hall, Ltd., 1960. 158p. $5.75.

Nine papers are included. The industrial implications as well as the theoretical chemistry of fuel cells as power supplies and chemical reactors are examined. The papers cover: introduction to fuel cells, the H_2-O_2 (air) fuel cell with C electrodes, catalysis of fuel-cell electrode reactions, electrode kinetics of low-temperature H_2-O_2 fuel cells, high-pressure H_2-O_2 fuel cells, high-temperature fuel cells, carbonaceous fuel cells, electrode processes in fuel gas cells, and molten alkali carbonate cells with gas-diffusion electrodes. A summary of the panel discussion is given. (D.L.C.)

118

THE CHEMISTRY OF YTTRIUM AND SCANDIUM. R. C. Vickery. International Series of Monographs on Inorganic Chemistry. Volume 2. New York, Pergamon Press, 1960. 128p. $6.50.

A concise treatment of the chemistry of yttrium and scandium is presented sequentially, i.e., history of the metals, modes of natural occurrence, physicochemical properties of both metals and compounds, and methods for separation, purification, and determination. Analysis of the metals in the presence of interfering elements is also treated. (D.L.C.)

119

IMPROVEMENTS IN OR RELATING TO PURIFICATION

OF TRI-n-BUTYL PHOSPHATE. Samuel Slater Grimley and John Kennedy (to United Kingdom Atomic Energy Authority). British Patent 848,791. Sept. 21, 1960.

Commercial tributyl phosphate (TBP) may be purified for solvent extraction purposes by heating with several times its volume of an aqueous solution of 0.5 N with respect to the TBP volume in an alkali metal hydroxide for 60 min to distill off some of the water. An example of such purification is given in which 100 parts commercial TBP and 500 parts of 0.1 N NaOH aqueous solution were heated for 60 min at 90 to 100°C, resulting in a 200-part distillate containing water, n-butanol, ammonia, and traces of butyraldehyde and TBP, an alkaline aqueous phase containing the sodium salt of dibutyl phosphate, and a 92-part TBP phase after washing with water. (D.L.C.)

Analytical Procedures

120 AERE-AM-61

United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England.

THE DETERMINATION OF GASES IN METALS USING THE SEMI-MICRO VACUUM FUSION TECHNIQUE. A. Parker. Aug. 1960. 13p. BIS.

The sample is introduced into a molten bath of platinum contained in a graphite crucible which is heated by means of a high-frequency induction heater. The evolved mixture of carbon monoxide, hydrogen, and nitrogen is analyzed by a low-pressure method. The method can be used in the determination of oxygen and hydrogen in iron, niobium, silicon, tantalum, thorium, titanium, tungsten, uranium, uranium carbide, vanadium, zirconium, and zirconium alloys and in the determination of oxygen in beryllium, boron, copper, and chromium. (auth)

121 CF-58-12-143

Oak Ridge National Lab., Tenn.

MEASUREMENTS OF SMALL AMOUNTS OF H_2O IN D_2O BY NEAR-INFRARED ABSORPTION SPECTROSCOPY. R. E. Biggers. Dec. 8, 1958. 7p. OTS.

The literature on the near-infrared and infrared absorption spectra of liquid H_2O and D_2O as well as other literature related to the determination of small amounts of one in the presence of the other was reviewed. Near-infrared absorption techniques appear to be very convenient, rapid, and almost ideally suited for the determination of H_2O in the concentration range from 0 to 10% in D_2O. The absorption spectra of H_2O, D_2O, (HDO), and of mixtures of H_2O in D_2O were obtained using a Cary Model 14 PM Recording Spectrophotometer. As expected, the H_2O was found to undergo very rapid and almost complete exchange to HDO, especially at relatively low H_2O concentrations. In agreement with some previously reported French and Japanese work, a relatively intense and very useful absorption band for HDO has been found at 1.668 μ, and it is used for the determination. By the use of the procedure described, 0.5, 2, 4, and 7 wt. % H_2O in D_2O can be determined with respective approximate relative standard deviations of 7, 2, 1, and 0.7% when 1-cm absorption cells are used in conjunction with a pure D_2O reference liquid. (auth)

122 DEG-Report-111

United Kingdom Atomic Energy Authority. Development and Engineering Group, Culcheth, Lancs, England.

THE DETERMINATION OF OXYGEN IN MAGNOX A12. R. Berry, J. A. J. Walker, and R. E. Johnson. June 9, 1960. 16p. BIS.

A method for determining oxygen in the magnesium alloy Magnox A12 is described. The magnesium is removed by sublimation at 800°C in vacuo; this is followed by vacuum fusion of the residue in an iron bath at 1700°C. (C.J.G.)

123 DP-492

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

COULOMETRIC TITRATION OF URANIUM IN NITRIC ACID SOLUTIONS. Myron O. Fulda. July 1960. 14p. Contract AT(07-2)-1. OTS.

A coulometric titration method was developed for the determination of uranium in HNO_3 solutions. Uranium was reduced to the (IV) state and was titrated with electrolytically generated cerium(IV). The colorimetric end point was detected automatically by a photometric technique. Interference from nitrate was eliminated by the addition of urea to the titration medium. The coefficient of variation for the analysis of uranium was 3.2% for 1-mg samples and 0.3% for 100-mg samples. With the addition of urea as much as 4.5 milliequivalents of nitric acid in a 1- to 3-ml sample was tolerated. (auth)

124 GAT-292

Goodyear Atomic Corp., Portsmouth, Ohio.

THE DETERMINATION OF URANIUM IN IMPURE SOLUTIONS USING AN ELECTRON BOMBARDMENT-TYPE MASS SPECTROMETER. C. D. Tabor, G. F. Kauffman, and F. S. Voss. Sept. 1, 1960. 12p. Contract AT(33-2)-1. OTS.

Presented at the American Society for Testing Materials, Committee E-14, Meeting on Mass Spectrometry, Atlantic City, New Jersey, June 28, 1960.

A method is described for the determination of uranium in impure solutions by using the isotopic dilution technique and the conversion of uranium to UF_6 for subsequent analysis on an electron bombardment type mass spectrometer. (C.J.G.)

125 HW-63824(p.11-14)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A SIMPLIFIED RADIOSTRONTIUM PROCEDURE USING CONCENTRATED NITRIC ACID. C. W. Thomas.

Procedures are described for determining Sr^{90} in samples containing calcium. (C.H.)

126 HW-63824(p.60-8)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

MEMBRANE ELECTRODE CELL FOR THE DETERMINATION OF DISSOLVED OXYGEN. Preliminary Report. R. W. Henkens.

A procedure is described for the rapid determination of oxygen down to 10^{-6} moles O_2/l by the use of small samples and without the necessity of adding reagents. (C.H.)

127 HW-65801

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

X-RAY SPECTROGRAPHIC DETERMINATION OF POTASSIUM, URANIUM, AND THORIUM IN PYROCHEMICAL SAMPLES. M. C. Lambert. June 20, 1960. 23p. Contract AT(45-1)-1350. OTS.

An x-ray spectrographic method is described for the determination of potassium, thorium, and uranium in aqueous pyrochemical solutions with the aid of internal standards to eliminate matrix effects. Precision for single determinations of potassium was ±0.22 g/l at the 2 σ-level. Precision was ±0.035 g/l for single determination of thorium and uranium in the concentration range below 2.0 g/l. (auth)

128 HW-66057

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

AN ELECTROCHEMICAL DETERMINATION OF SUBMICROGRAM QUANTITIES OF MOLYBDENUM. H. E. Palmer. July 12, 1960. 22p. Contract AT(45-1)-1350. OTS.

An electrochemical procedure for the determination of molybdenum is described. The method is based on the measurement of the catalytic effect of molybdenum in the reduction of perchloric acid at a mercury cathode. Molybdenum as low as 0.1 μg may be determined with a standard deviation of 3×10^{-3} μg. The method is specific with vanadium, tungsten, and ruthenium as the only commonly occurring interfering elements. Concentrations of those elements equal to that of the molybdenum can be tolerated. (auth)

129 PG-Report-128

United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England.

ANALYTICAL METHOD FOR THE GENERAL GRAVIMETRIC DETERMINATION OF URANIUM IN ORES AND CONCENTRATES. 1960. 10p. BIS.

The preliminary treatment essentially consists in dissolving the sample in HNO_3 with the addition, if necessary, of HF. The solution is evaporated to dryness and then dissolved in a mixed nitrate solvent. The $UO_2(NO_3)_2$ is eluted from a cellulose column while the impurities remain on the column. Uranium in the eluate is precipitated as ammonium diuranate, which is dried and then ignited to U_3O_8. (auth)

130 PG-Report-129

United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England.

ANALYTICAL METHOD FOR THE GRAVIMETRIC DETERMINATION OF URANIUM IN IMPURE LIQUORS AND SOLID RESIDUES CONTAINING MORE THAN 2% URANIUM. 1960. 13p.

The uranic solution as received or obtained by treatment of solid residues is purified by passing it through a cellulose column in which ether-HNO_3 is used as an eluant. After the removal of the ether from the eluate, the uranium is precipitated as ammonium diuranate, and this is converted by ignition to uranoso-uranic oxide, which is weighed. (auth)

131 PG-Report-130

United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England.

ANALYTICAL METHOD FOR THE DETERMINATION OF URANIUM IN SPRINGFIELDS EFFLUENTS AND CONTRIBUTORY DISCHARGES. 1960. 14p.

An aliquot sample is concentrated by evaporation and the uranium converted to the nitrate, which is then extracted into ether. After extraction, the ether is removed and the uranium determined absorptiometrically by using H_2O_2. (auth)

132 PG-Report-131

United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England.

ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF URANIUM IN SOLID RESIDUES FROM ORE DISSOLVING. 1960. 7p. BIS.

A ground sample is treated with HF. The residue is dissolved with HNO_3 and extracted with ether, which is then distilled off. The residue is oxidized with $HClO_4$ and HNO_3. The uranium is determined spectrophotometrically by using H_2O_2. (auth)

133 PG-Report-132

United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England.

ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF URANIUM IN IMPURE LIQUORS CONTAINING LESS THAN 2% URANIUM. 1960. 7p. BIS.

A sample aliquot is evaporated to dryness, dissolved in HNO_3, and the uranium extracted with ether. After removal of the ether and destruction of all organic matter, the uranium is determined spectrophotometrically after addition of H_2O_2. (auth)

134 PG-Report-133

United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England.

ANALYTICAL METHOD FOR THE PRECISE DETERMINATION OF URANIUM IN PURE URANYL NITRATE SOLUTIONS. 1960. 6p. BIS.

Ammonia is added to a heated sample. The precipitate is separated by filtration and ignited to U_3O_8, in which form it is weighed. (auth)

135 USNRDL-464

Naval Radiological Defense Lab., San Francisco.

QUANTIATIVE RADIOCHEMICAL CARRIER-FREE PROCEDURES. L. Wish and E. C. Freiling. July 8, 1960. 36p.

A carrier-free procedure for the separation and determination of fission products and induced radionuclides is described. A method for calibrating gamma well type counters and spectrometers for the determination of absolute disintegration rates is included. (C.J.G.)

136 USNRDL-TR-443

Naval Radiological Defense Lab., San Francisco.

THE COCRYSTALLIZATION OF ULTRAMICRO QUANTITIES OF ALKALI METALS WITH AMMONIUM DIPICRYLAMINATE. H. V. Weiss and M. G. Lai. July 7, 1960. 14p.

The cocrystallization of ultramicro quantities of alkali metals with ammonium dipicrylaminate was investigated. Radiotracer techniques were employed to measure the quantitative removal of these elements. Conditions were developed for the separation of potassium, rubidium, and cesium as a group by this process; sodium remained largely associated with the mother liquor. (auth)

137 USNRDL-TR-449

Naval Radiological Defense Lab., San Francisco.

THE DETERMINATION OF RADIUM IN URINE. H. V. Weiss and M. G. Lai. June 17, 1960. 12p.

A rapid and accurate procedure was developed for the determination of radium in urine. The method depends upon the cocrystallization of radium from urine with potassium rhodizonate and purification of this extract by ion exchange. The recovery of radium from urine in 11 determinations was 94.9 ± 3.3%, and the isolated radioactivity was essentially residue-free. (auth)

138 USNRDL-TR-450

Naval Radiological Defense Lab., San Francisco.

THE DETERMINATION OF PLUTONIUM IN URINE. H. V. Weiss and W. H. Shipman. June 17, 1960. 15p. Project No. NS-081-001.

An improved method was developed for the determination of plutonium in urine. Plutonium is cocrystallized with potassium rhodizonate from urine, and separated from interfering substances by coprecipitation with lanthanum followed by ion exchange. Finally, the radioelement is electrodeposited onto a tantalum disc and alpha counted. The analysis required 5 to 6 hr. (auth)

139 WIN-118

National Lead Co., Inc. Winchester Lab., Winchester, Mass.

THE DETERMINATION OF ISOTOPIC RADIUM. E. J. Baratta and A. C. Herrington. Sept. 1, 1960. 27p. Contract AT(49-6)-924. OTS.

An analytical procedure is presented for the rapid determination of the three naturally-occurring α-emitting radium isotopes. Total radium is precipitated with barium carrier, dissolved, and purified by solvent extraction. The concentrations of each of the radium isotopes are determined by selective extraction of the lead and bismuth daughters at suitable times. Ra^{223} is determined by counting 36-min. Pb-Bi^{211}, Ra^{224} by counting 1-hr Bi^{212}, and Ra^{226} by counting 20-min. Bi-Po^{214}. Very low-level determinations are possible. (auth)

140 CEA-tr-I-37

SUR UNE MÉTHODE RAPIDE POUR DOSER LE ^{210}Po DANS LES MINERAIS RADIOACTIFS. (A Rapid Method for Determination of Po^{210} in Radioactive Ores). L. Ancarani and L. Riva. Translated into French from p.155-9 of Studi e Ricerche Della Divisione Geomineraria, Volume II. 1959. 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 19225.

141 CEA-tr-R-815

METHODES SPECTRALES POUR LE DOSAGE DES TRACES D'IMPURETES. (Spectral Methods for Determination of Traces of Impurities). Sh. I. Peizulaev (Peyzulayev), A. G. Karabash, L. S. Krauz, F. A. Kostareva, N. I. Smirnova-Averina, F. L. Babina, L. I. Kondrat'eva (Kondratieva), E. F. Voronova, and V. M. Meshkova. Translated into French from Zavodskaya Lab. 24, 723-31(1958). 20p.

Spectrochemical methods are given for analysis of strontium, chromium, silicon and their compounds. The impurities are chemically concentrated before spectroscopy, increasing the sensitivity of the method 20 times or more. (T.R.H.)

142 CEA-tr-R-867

MÉTHODE RAPIDE DE DÉTERMINATION DE L'HYDROGÈNE DANS LE TITANE METALLIQUE EN POUDRE. (Rapid Method of Determination of Hydrogen in Titanium Metal Powder). R. N. Rubinshteĭn (Rubinstein) and N. G. Mendlina. Translated into French from Zavodskaya Lab. 25, 34-6(1959). 10p.

Two simple and rapid variations of a method for determining hydrogen in titanium powder are described. The method is based on measurement of the H_2 pressure over titanium heated to 600 or 700°C. In the first variation, the pressure is measured during continuous evacuation of H_2 across a capillary tube. The second variation consists in measuring the equilibrium pressure of H_2 which is established after a partial evacuation. The continuous-pumping method is faster and more precise than the successive-pumping method, but the calculations are more complex. (T.R.H.)

143 CEA-tr-X-203

DÉTERMINATION DU BORE À L'ÉTAT DE TRACES DANS LES GRAPHITES, LES CHARBONS, LES COKES ET LES SUIES PAR LA MÉTHODE D'ANALYSE PAR SPECTRE D'ÉMISSION. I. (Determination of Traces of Boron in Graphites, Carbons, Cokes and Soots by Emission Spectrum Analysis. [Part] I). S. Skalska and S. Held. Translated into French from Chem. Anal. (Warsaw) 1, 294-300(1956). 13p.

A review is presented of methods of determining boron in the range of 0.1 to 2 μg/g, followed by an experimental study of a spectrophotometric method. A Hilgar high-dispersion prismatic spectrograph was used with a Swienticki a-c arc excitation source for steels, and a Hilgar microphotometer was also used. The Shugar method for standard and sample preparation was used. (T.R.H.)

144 WAL-142/59-7

Paris. Université.

APPLICATION OF ELECTRON PROBES TO LOCAL CHEMICAL AND CRYSTALLOGRAPHIC ANALYSIS. Raymond Castaing. Translation of a thesis: "Application Des Sondes Electroniques A Une Methode D'Analyse Ponctuelle Chimique et Cristallographique," June 8, 1951. 163p.

Issued by California Inst. of Tech. as Interim Technical Report No. 3.

The design and construction of an electron probe apparatus are described. Conditions for quantitative analysis are discussed. Corrections for absorption of x rays in the anode and for fluorescence are discussed. The application of electron probes in chemical and crystallographic analyses is discussed. (C.J.G.)

145

DETERMINATION OF ACTIVATED IMPURITIES IN SEMICONDUCTOR-GRADE SILICON BY γ-SPECTROGRAPHY. V. Cojocaru, M. Cristu, D. Dorcioman, and M. Bădănoiu. Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz. 11, 447-54(1960). (In Rumanian)

For detecting the short half-life isotopes remaining in chemically pure silicon and in specially remelted samples, the specimens were irradiated for 4.5 hr in the thermal neutron flux of 1.5×10^{11} neutron/cm^2/sec in the thermal column of the Institute's reactor. The activated impurity elements were determined by means of a NaI(Tl) crystal scintillation γ-spectrograph, starting the tests within 2 hr after the end of the irradiation. No radiochemical separations were performed and no control specimens were used. It was found that antimony, copper, and strontium were present in concentrations of 5.8×10^{-4}, 1.8×10^{-4}, and 1.9×10^{-3}%, respectively; the concentration of these elements in the remelted samples was somewhat reduced. The data are subject to an error of about 25 to 35%, caused by the uncertainty of the exact values of the total flux and of the activation cross sections. (TTT)

146

MOLTEN SALT MIXTURES AS LIQUID PHASES IN GAS CHROMATOGRAPHY. Walter W. Hanneman, Charles F. Spencer, and Julian F. Johnson (California Research Corp., Richmond). Anal. Chem. 32, 1386-8(1960) Oct.

A new column for gas chromatography permits operation at 150 to over 400°C. The column packing is an inorganic salt eutectic on firebrick. A typical composition is a mixture of sodium, potassium, and lithium nitrates supported in a conventional manner on crushed insulating brick. The melting point of this eutectic is about 150°C. The upper limit of operation is determined by the thermal stability of the sample. The resolution of the column is relatively low compared to conventional organic packings. Retention volumes are low, permitting use of long columns. The column packing material is described and tables showing the resolution on various types of organic compounds, particularly polyphenyls, are presented. (auth)

147

COULOMETRIC DETERMINATION OF EUROPIUM AND

YTTERBIUM AT CONTROLLED POTENTIAL. Edward N. Wise and Edward J. Cokal (Univ. of Arizona, Tucson). Anal. Chem. 32, 1417-19(1960) Oct.

Europium and ytterbium were determined individually by the one-electron reduction of their trivalent ions in methanolic tetraethylammonium bromide, with a mean absolute error 0.05 microequivalent in the sample range 0.5 to 20 microequivalent. The reduction of ytterbium was induced by the reduction of europium, so that only their sum could be determined by reduction in samples containing both elements. In such cases, europium was determined in a separate aliquot by coulometric oxidation in 0.1 M hydrochloric acid, and ytterbium was found by difference. (auth)

148

METHODS FOR SEPARATION AND DETERMINATION OF BERYLLIUM IN SEDIMENTS AND NATURAL WATERS. John R. Merrill, Masatake Honda, and James R. Arnold (Princeton Univ., N. J.). Anal. Chem. 32, 1420-6(1960) Oct.

In the course of studies on natural beryllium isotopes, methods were developed for spectrophotometric determination of beryllium in silicates at the ppm level, for separation and purification of beryllium at this concentration from large sediment samples by solvent extraction and cation exchange, and for radiochemical purification of beryllium. The use of dispersed insoluble hydroxides on cation exchange columns permits rapid removal of beryllium, at concentrations below 10^{-10} M, from large volumes of sea water. This method is of more general applicability. The nature of the reaction was studied. (auth)

149

FLUORESCIMETRIC DETERMINATION OF RUTHENIUM. Hans Veening and Warren W. Brandt (Purdue Univ., Lafayette, Ind.). Anal. Chem. 32, 1426-8(1960) Oct.

A fluorescimetric method for the determination of ruthenium uses the tris(5-methyl-1,10-phenanthroline)-ruthenium(II) complex. With this method 1 γ per ml of ruthenium can be determined with no interference from 25 γ per ml of osmium. The useful range of concentration is 0.3 to 2.0 γ per ml of ruthenium with an average accuracy of ±2%. The other platinum metals do not interfere. Iron is a serious interference. (auth)

150

SPECTROPHOTOMETRIC DETERMINATION OF TECHNETIUM(VII) WITH THIOGLYCOLIC ACID. F. J. Miller and P. F. Thomason (Oak Ridge National Lab., Tenn.). Anal. Chem. 32, 1429-30(1960) Oct.

A spectrophotometric method of analysis for technetium(VII) was developed to supplement the radiochemical and polarographic methods that are now used in laboratories of radiochemical processing plants. Technetium is determined as the pertechnetate ion in the concentration range from 2 to 40 μg per ml in the final solution by measuring at 655 mμ the intensity of the color that is formed at pH 8.0 with thioglycolic acid. Beer's law is obeyed over this range. The molar absorptivity is estimated to be of the order of 1800. Few anions interfere. The time required for the determination is short, and the technique is simple. (auth)

151

FLUOROMETRIC DETERMINATION OF URANIUM IN ZIRCONIUM AND HAFNIUM. P. A. Vozzella, A. S. Powell, R. H. Gale, and J. E. Kelly (Combustion Engineering, Inc., Windsor, Conn.). Anal. Chem. 32, 1430-3(1960) Oct.

The extraction of microgram quantities of uranium with ethyl acetate was found suitable for the determination of trace amounts of uranium in zirconium. Half-gram samples are dissolved in nitric and hydrofluoric acids, the hydrofluoric acid is removed, and the solution is made up to a definite volume. An aliquot is pipetted into a vial containing a salting agent and the uranium extracted with ethyl acetate. The amount of uranium in the organic layer is determined fluorometrically. Any quenching occurring is compensated by control standards. The concentration of uranium in hydrofluoric-nitric acid pickling baths is determined by the standard addition of uranium to a duplicate of the sample being analyzed. Study of the variables in fluorometric determination of uranium has indicated those that must be controlled for best precision and accuracy. (auth)

152

THE ANALYSIS OF METAL CHELATES BY GAS CHROMATOGRAPHY. W. J. Biermann and Hyman Gesser (Univ. of Manitoba, Winnipeg, Can.). Anal. Chem. 32, 1525-6 (1960) Oct.

Gas chromatography was used for the analysis of metals in the form of acetylacetonato complexes. The method was particularly well-suited for beryllium determinations. The combination of solvent extraction and complex formation should make the method exceedingly useful. The use of glass-bead columns permitted rapid elution of beryllium, aluminum, and chromium acetylacetonato complexes at temperatures well below those at which thermal decomposition is significant. Chromatograms are given showing the separation of aluminum and beryllium in acetylacetone and aluminum and chromium in carbon tetrachloride. (B.O.G.)

153

PHOTOMETRIC DETERMINATION OF BORON BY SOLVENT EXTRACTION USING MONOMETHYLTHIONINE. Laszlo C. Pasztor and J. Daniel Bode (Jones and Laughlin Steel Corp., Pittsburgh). Anal Chem. 32, 1530-31(1960) Oct.

The successful modification and application to steel analysis of Ducret's methylene blue-boron method lead to a study of other thionine derivatives. Of the commercially available compounds, Azure C monomethylthionine (MMT) proved to be superior to methylene blue. The absorbance maximum for the MMT–BF_3 complex in several organic solvents and mixtures occurs at 658 mμ. As with methylene blue, alloying elements in the ranges commonly found in steel give no interference. This work was conducted to eliminate two disadvantages of the methylene blue procedure—viz., the high reagent blank which makes dilution of the extract necessary and the relatively narrow concentration range, 0.2 to 25 γ of boron, which requires extreme aliquoting of high boron solutions. (B.O.G.)

154

RAPID DEUTERIUM DETERMINATION IN THE PRESENCE OF AIR. P. H. Dutch (Fluor Corp., Ltd., Whittier, Calif.). Anal. Chem. 32, 1532(1960) Oct.

A method is described for separating deuterium in hydrogen streams at 30 to 70% deuterium. The method is based on thermal conductivity for sensitivity and simplicity. A gas chromatograph equipped with a gas-sampling cell was used to analyze small (5 to 10 ml) samples. Small air leaks into the system resulted in a need for a column packing to separate deuterium from air or to separate the three components—deuterium, oxygen, and nitrogen—in the presence of hydrogen. By observing the ratio of O_2 to N_2 it was possible to detect whether the leaks that developed were in the sampling system or in the D_2–H_2 reaction vessel. The separation and experimental details are pre-

sented from which the D_2 sensitivity was calculated to be ~500 ppm for a 5-ml sample. (B.O.G.)

155

ANALYTICAL SPECTROSCOPY OF THE RARE EARTHS. Velmer A. Fassel (Ames Lab., Ames, Iowa). Anal. Chem. 32, 19A-20A; 22A-24A; 26A; 28A; 30A; 32A-34A; 36A-38A; 40A-42A; 44A; 46A(1960) Oct.

Uniformity in the outer electron shell of the rare earths makes the members difficult to differentiate chemically. The difference occurs in the 4f subshell. The 4f electrons play a more active role in determining relative stabilities of the electronic configuration when the 4f subshell is nearly empty, half-filled, or nearly full. Aside from the existence of the so-called anomalous oxidation states, the small differences in the chemical properties can be traced to a progressive decrease in atomic radius as the atomic number increases. Though the 4f electrons play a negligible role in determining the chemical properties, they play a leading role in establishing energy states within the atomic system. The energy states in the individual atoms are as unique as they are for other elements and energy transitions between the states produce spectra that are highly specific. These spectra are the most powerful properties of the rare earths available for exploitation. The applications of various spectra to the analysis of rare-earth mixtures, to appraisal of purities, and to the determination of rare earths in other matrices are discussed. Primary emphasis is placed on discussions of those techniques that have found general applications. (B.O.G.)

156

THE CHELOMETRIC DETERMINATION OF ALUMINUM, NICKEL AND MANGANESE WITHOUT PRIOR SEPARATION. D. H. Wilkins (General Electric Co., Research Lab., Schenectady, N. Y.). Anal. Chim. Acta 23, 309-11 (1960) Oct. (In English)

Hydroxyethylethylenediaminetriacetic acid is used as a selective reagent for the chelometric determination of aluminum and nickel in the presence of manganese. Manganese is subsequently determined in the same solution by means of a direct EDTA titration. The reagent for the first titrations serves as a masking agent during the manganese determination. Methyl Calcein or Methyl Calcein Blue serves as a metal-fluorechromic indicator for the determinations. (auth)

157

DERIVATIVES OF 1,4-DIHYDROXYANTHRAQUINONE AS METAL INDICATORS IN THE TITRATION OF THORIUM WITH DISODIUM EDTA. E. Guy Owens, II and John H. Yoe (Univ. of Virginia, Charlottesville). Anal Chem. Acta 23, 321-4(1960) Oct. (In English)

2-Quinizarinsulfonic acid (sodium salt) and 2-phenoxyquinizarin-3,4'-disulfonic acid (dipotassium salt) can be successfully used as metal indicators in the titration of thorium with disodium EDTA. The latter compound is recommended in preference to the former and Alizarin Red S as an indicator because it permits the titration to be made over a wider pH-range. (auth)

158

DETERMINATION OF FLUORINE IN BERYLLIUM. J. F. W. Smith and R. H. A. Crawley (English Electric Co. Ltd., Whetstone, Eng.). Anal. Chim. Acta 23, 345-50(1960) Oct. (In English)

Various reagents for the determination of fluorine in beryllium were investigated and a method is described using the zirconium sulfophenylazodihydroxynaphthalene disulfonic acid (SPADNS) complex. The fluoride is steam distilled from a sulfuric acid solution, under carefully controlled conditions, and aliquots of the distillate are treated with the reagent and measured spectrophotometrically at 5900 A. Interference by beryllium and by sulfate ions is discussed. (auth)

159

A REINVESTIGATION OF THE DETERMINATION OF THORIUM WITH SPADNS. J. A. Cooper and M. J. Vernon (Australian National Univ., Canberra). Anal. Chim. Acta 23, 351-4(1960) Oct. (In English)

A reinvestigation is reported of the spectrophotometric microdetermination of thorium with SPADNS, 2-p-sulfophenylazo-1,8-dihydroxy-naphthalene-3,6-disulfonic acid. It is shown that the practical lower limit of determination is 10 μg against a previously reported value of 0.04 μg. Increasing macroquantities of acetate are shown to reduce the developed color finally removing it. The molecular ratio of combination of thorium–SPADNS is confirmed as being 1:1. (auth)

160

THE SPECTROPHOTOMETRIC DETERMINATION OF VANADIUM AS MOLYBDOVANADIC ACID. Gerald W. Wallace and M. G. Mellon (Purdue Univ., Lafayette, Ind.). Anal. Chim. Acta 23, 355-62(1960) Oct. (In English)

A colored complex formed by the condensation of the oxy-acids of molybdenum(VI) and vanadium(V) in a 5 to 1 ratio is used as the basis for a spectrophotometric method for vanadium. The absorbance of the intense yellow complex is measured at 360 mμ. The color is stable for at least 24 hr and follows Beer's law at a concentration of $2 \cdot 10^{-5}$ to $6 \cdot 10^{-4}$ M vanadium. A standard deviation of 0.056% in steel samples containing 2.04% vanadium was obtained for five determinations. Factors affecting the color formation and the analytical applications to the determination of vanadium are presented. (auth)

161

THE DETERMINATION OF FREE ACID IN PLUTONIUM SOLUTIONS. J. L. Pflug and F. J. Miner (Dow Chemical Co., Denver). Anal. Chim. Acta 23, 362-7(1960) Oct. (In English)

A method for the determination of free acid in the presence of plutonium was evaluated. It involves the use of a complexing agent to prevent interference from the hydrolysis of plutonium. Of the complexing agents investigated, the citrate ion was found the most efficient. The end-point is detected potentiometrically. The standard deviation, calculated from data obtained by the repeated analysis of a 7.46 N solution, is ±0.06 N. (auth)

162

SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM IN MAGNESIUM-BASE ALLOY. Shozo Shibata, Yoshio Ishiguro, and Teiichi Matsumae (Government Industrial Research Inst., Nagoya, Japan). Anal. Chim. Acta 23, 384-7(1960) Oct. (In English)

A rapid spectrophotometric determination of zirconium with neothoron is described. Large amounts of magnesium and moderate amounts of many heavy metals have no effect. The method is applicable to the direct determination of zirconium in magnesium–base alloys. (auth)

163

FLAME-PHOTOMETRIC METHODS IN METALLURGICAL ANALYSIS. John A. Dean (Univ. of Tennessee, Knoxville). Analyst 85, 621-9(1960) Sept.

Applications of flame photometry to the analysis of metallurgical products are not so widespread as the utility of the technique warrants. The method should be of interest

to analysts in production and control laboratories, especially where no spectrographic facilities are available. Among the conventional combustible gases, an oxygen–acetylene flame, into which is aspirated an organic solvent, offers the optimum excitation conditions. In such a flame more than 57 elements are excited, and 43 of these can be determined with high sensitivity. The emission sensitivities of these elements are tabulated elsewhere, with those pertinent to metallurgical analysis included. If the limits of detection are of interest, the compilation by Gilbert should be consulted. An advantage of flame photometry is that, compared to an arc or spark source, flames excite fewer lines of each element, making less difficult the establishment of reproducible conditions of excitation and sample introduction by means of an aerosol. The development of the oxygen-cyanogen flame offers promise for the excitation line spectra of elements whose lines are weak or absent in oxygen–hydrogen or oxygen-acetylene flames. The methods used for preparing the sample, injection into the flame, and flame analysis are described for the alkali metals, Al, Be, B, Cd, Ca, Cr, Co, Cu, Ga, In, Fe, Pb, Mg, Mn, Ni, Pt metals, rare earths, Ag, and Zn. (B.O.G.)

164

THE SEPARATION OF PALLADIUM FROM NIOBIUM AND ZIRCONIUM. J. F. Duke and W. Stawpert (National Physical Lab., Teddington, Middx., Eng.). Analyst 85, 671-2 (1960) Sept.

The separation of palladium from either niobium or zirconium by extraction from an acid iodide solution into isobutyl methyl ketone was successfully carried out. Although palladium is virtually completely extracted, no significant traces of niobium or zirconium could be detected in the organic phase. (auth)

165

RADIOMETRIC DETERMINATION OF POTASSIUM IN SILICATES. Paul E. Damon, Carl E. Hedge, Omer J. Taylor, and Carroll Halva (Univ. of Arizona, Tucson). Ariz. Geol. Soc. Digest. 3, 75-80(1960).

A radiometric method for determining potassium in silicon was developed which required no chemical preparation. Alpha and beta activities were determined. The beta count was then reduced by an empirical correction for the betas resulting from the uranium and thorium series. The alpha count determined the magnitude of the correction. The corrected beta count was compared with a standard sample of potassium to determine the potassium content. A comparison was made of radiometric analyses and other methods for a number of silicate rocks and minerals. (M.C.G.)

166

SEPARATION OF LANTHANONS BY PAPER PRECIPITATION CHROMATOGRAPHY WITH 8-QUINOLINOL. I. SEPARATION AND DETECTION OF LANTHANUM, CERIUM AND PRASEODYMIUM. PART I. Hideo Nagai (Kumamoto Univ., Japan). Bull. Chem. Soc. Japan 33, 715-17(1960) June. (In English)

The effects of using acetic acid saturated with isobutanol and n-butyric acid saturated with isobutanol as different developing solvents are discussed. When the latter was used, the separation of cations was achieved at a higher concentration than for the acetic acid system. Coprecipitation was minimized by increasing the acidity of the developing solvent. (B.O.G.)

167

A RAPID METHOD FOR DETERMINING FISSION PRODUCTS CONTAINED IN WATERS USING AN ION EXCHANGER. Hiroyuki Tsubota and Yasushi Kitano (Nagoya Univ., Japan). Bull. Chem. Soc. Japan 33, 765-9(1960) June. (In English)

A procedure is described for separating alkali, alkaline earth, and rare earth elements contained in mixed fission products, by using a formate buffer solution. The method may be used for determining fission products in natural waters and for preparing pure and carrier-free radioactive elements from mixed fission products. The characteristics of a good elutriant are outlined. (B.O.G.)

168

SPECTROPHOTOMETRIC DETERMINATION OF TRACES OF BORON IN URANIUM. Hiroshi Onishi, Nasumi Ishiwatari, and Hitoshi Nagai (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan 33, 830-5(1960) June. (In English)

A procedure is described for the spectrophotometric determination of 0.1 to 1 ppm of boron in uranium (metal, U_3O_8, and uranyl sulfate). Uranium metal was first converted to U_3O_8, and the oxide was dissolved in sulfuric acid and hydrogen peroxide. Boron was separated by distillation as methyl borate from sulfuric acid solution, and finally determined by the curcumin method. (auth)

169

MASS SPECTROMETRIC MEASUREMENTS OF UF_6. L. Debenec, V. Kramer, J. Marsel, and V. Vrscaj. "J. Stefan" Inst. Repts. (Ljubljana) 5, 33-9(1958). (Translated from Referat. Zhur. Fiz. No. 3, 1960, abstract No. 5143)

A Nier type 60° mass spectrometer with a resolution of 350 was used to measure the isotopic ratio U^{238}/U^{235} when UF_6 was introduced into the instrument. The UF_6 could be introduced in a viscous stream through two capillaries from vessels located in a thermostatic bath. One vessel contained UF_6 with natural contents of isotopes. The measurement of the isotopic ratio was carried out by comparing the intensity of the mass lines 330 and 383 in multiple magnetic or electric scanning. For exact measurements of small differences in the isotopic ratios of two specimens, use was made of the method of successive inlet of the samples. The "memory" effect of the instrument to old previously admitted samples was investigated. It was shown that in the case of a small difference in the isotopic ratios of the specimen, it was enough to stop the apparatus for 2 min for evacuation between measurements. It was established that the isotopic ratio U^{238}/U^{235} in natural uranium is 138.2 ± 0.4.

170

PREPARATION OF URANIUM SAMPLES FOR MASS SPECTROMETRIC ANALYSIS. J. Slivnik and A. Zemljič. "J. Stefan" Inst. Repts. (Ljubljana) 5, 49-51(1958). (Translated from Referat. Zhur. Fiz. No. 3, 1960, abstract No. 5142)

Equipment for the preparation of samples of UF_6 intended for mass spectrometric isotopic analysis is described. The equipment consists of the following basic parts: generator of elementary fluorine, reaction tube, and traps. The generator consists of an electrolytic cell with electrolyte $KF \cdot 2HF$. The F_2 was directed into the reaction tube and heated to 540°C. At this temperature the fluoridation reaction terminated after 10 min. The UF_6 produced was condensed in the trap, which was cooled with dry ice. Approximately 1 hr was necessary to prepare 80 mg of UF_6. The change-over of uranium to UF_6 amounted to approximately 92%.

171

ISOTOPIC ANALYSIS OF BORON IN BORON TRIFLUORIDE BY MASS SPECTROMETRY, AND MEASUREMENT OF NATURAL BORON 10 CONCENTRATION. P. G. Bentley

(United Kingdom Atomic Energy Authority, Capenhurst, Chester, Eng.). J. Sci. Instr. 37, 323-8(1960) Sept.

A conventional mass spectrometer is used for precise measurements of the isotope ratios of boron in boron trifluoride samples with widely differing concentrations of boron-10. "Memory" effects caused by the adsorption of boron trifluoride on to the surfaces of the inlet system were investigated, and it was found that these can be reduced to a workable level by careful design of the inlet system. By blending together enriched and depleted boron trifluoride, standard samples with known isotopic constitutions are prepared and used to calibrate the mass spectrometer. The true and measured isotope ratios are thus found to differ by several per cent, an effect attributed to mass discriminations in the ion source. After correcting for this error, the boron-10 atomic concentration in some naturally occurring boron is found to be 19.27 ± 0.13%. (auth)

172

RAPID ANALYSIS OF ERBIUM BY NEUTRON ACTIVATION FOLLOWED BY γ-RAY SPECTROMETRY. Minoru Okada (Government Chemical Industrial Research Inst., Tokyo). Nature 188, 52(1960) Oct. 1.

A method was developed for determining erbium by neutron activation to Er^{167m}. In the resulting γ spectrum, the height of the photopeak due to the 0.208 Mev γ ray was measured. The relation between photopeak height and the amount of erbium was obtained by use of standards. (M.C.G.)

173

INVESTIGATIONS CONCERNING EMISSION SPECTRUM ANALYSIS. IV. SPECTROGRAPHIC ANALYSIS OF HAFNIUM IN ZIRCONIUM OXIDE. (2) INVESTIGATION ON SIFTER ELECTRODE-SPARK EXCITATION. Shoushiro Sakai. Tokyo Kôgyô Shikensho Hôkoku 55, 241-6 (1960) July. (In Japanese)

A method was devised for the determination of hafnium in zirconium oxide as reactor material. The "Sifter electrode-spark excitation technique" employed by C. Feldman and J. Y. Ellenburg was utilized and the sensitivity extended to 100 ppm hafnium. In this technique samples, finely ground and mixed with equal amounts of graphite powder, were put into the "sifter electrode" used as the upper electrode and excited in ARL multisource oscillating spark. A marked improvement was made in the ratio of signal to noise for hafnium spectral line, but the sensitivity was not sufficient. (auth)

174

SUCCESSIVE DETERMINATION OF THORIUM AND OF THE SUM OF RARE EARTH ELEMENTS BY THE COMPLEXONE METHOD. Yu. A. Chernikhov, R. S. Tramm, and K. S. Pevzner (State Scientific Research and Planning Inst. of Rare Metal Industry, USSR). Zavodskaya Lab. 26, 921-4(1960). (In Russian)

Instead of the usual coprecipitation of thorium and the rare-earth elements, relying on the subsequent separation of thorium by the iodate or the urotropine method, the two were titrated in turn in the same solution, without separation, by adjusting the pH of the solution. At low pH values, the selectivity of the method increases considerably, and the indicators must be chosen according to the pH range. A mixture, containing oxides of Ce, Nd, Pr, Sm, and small amounts of elements of the Y group in addition to Th, Fe, Mn, Ti, and Al, was prepared from the mineral loparite. The thorium was determined by titrating the buffered solution at pH of about 2 with a 0.02 M solution of Complexone III. At a pH value of 1.5, even a tenfold excess of the rare-earth element can be tolerated. The inhibiting action of Fe^{3+} can be counteracted by reducing it with ascorbic acid. Nitrates and sulfates do not interfere, but phosphates must be removed prior to the titration. The rare earth elements are then titrated at a pH of 4.5, after reduction of the cerium. (TTT)

175

DETERMINATION OF THORIUM AND OF ZIRCONIUM BY COMPLEX FORMATION IN MAGNESIUM ALLOY. R. S. Volodarskaya. Zavodskaya Lab. 26, 925-7(1960). (In Russian)

Arsenaso was found to be the most suitable indicator for the colorimetric determination of thorium with Trilon B, as it forms a stable complex with thorium in strongly acid medium. Magnesium alloys containing up to 4% thorium and up to 1% zirconium were successfully analyzed by this method without interference by Mg, Zn, Al, Mn, or Cd. The Ce^{4+} must be reduced before the titration. The zirconium is determined by backtitrating the excess of the Trilon B with $FeCl_3$ at pH = 2.0 to 2.5 in the presence of sulfosalicylic acid. If both thorium and zirconium are present in the same sample, the zirconium must be separated previously with phenylarsonium acid, completing the zirconium determination in the precipitate by complex formation, titrating it with Trilon B. (TTT)

176

PHOTOCOLORIMETRIC DETERMINATION OF ZIRCONIUM IN THE FORM OF A PHOSPHORUS–MOLYBDENUM–ZIRCONIUM COMPLEX. R. M. Veĭtsman (All-Union Scientific Research Inst. of Hard Alloys, USSR). Zavodskaya Lab. 26, 927-9(1960). (In Russian)

It was found that zirconium has complexing properties similar to those previously established for Ti, V, Os, and Nb, forming phosphoro-molybdo-titanium heteropoly acids which may be used for its analytical determination. The yellow complex is reduced by $SnCl_2$ in 2N H_2SO_4 medium under the formation of a blue coloration, without changing the heteropoly acid structure. Excess phosphate slows down the complex formation. The presence of Complexon enhances the optical saturation of the blue coloration. Calcium citrate must be added to prevent hydrolysis of the zirconium. The intensity of the coloration is measured on a photocolorimeter, using a red filter. The presence of W, Co, Nb, Ta, and Fe does not interfere with the determination of the zirconium. (TTT)

177

THE ANION EFFECT AT THE DETERMINATION OF RARE EARTH ELEMENTS BY FLAME PHOTOMETRY. N. S. Poluektov and L. A. Ovchar (Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zavodskaya Lab. 26, 964-6(1960). (In Russian)

During the flame photometric investigation of lanthanum and other rare-earth elements it was noticed that the presence of certain acids and salts exerts a great effect on the intensity of the spectra. Specifically, studies with YCl_3 and $YbCl_3$ showed that addition of H_2SO_4 to the solution quenches the intensity of the line; H_3PO_4 has a similar effect. The reason for this behavior lives in the formation of nonvolatile compounds. Closer study of the flame photometric intensity of the peaks showed that in solutions containing H_2SO_4 the compounds formed contained bivalent europium and ytterbium and trivalent erbium and yttrium, whereas in the presence of H_3PO_4 all the investigated rare-earth elements were present in their trivalent form. (TTT)

178

RADIOMETRIC DETERMINATION OF THORIUM IN TUNGSTEN AND MOLYBDENUM. L. N. Aleksandrov (State

Scientific Research Inst. of Light Sources, USSR). Zavodskaya Lab. 26, 975-7(1960). (In Russian)

The radiometric determination of thorium based on the measurement of the natural α emission of Th^{232} can be executed very simply, requires no reference standard, and makes possible the measurement of thorium concentration in tungsten and molybdenum wires during fabrication. A highly sensitive silver-activated ZnS screen was used together with a photoamplifier for determining the thorium content in less than 10 min with a precision at the 0.05% level. Using longer counting periods than the usual 3 min and larger samples increases the precision of the determination. The method is nondestructive and may be used during the heat treatment of the specimens. (TTT)

179

PHOTOMETRIC DETERMINATION OF CERIUM BY MEANS OF O-TOLIDINE. N. Iordanov and Khr. Daiev (Sofia State Univ.). Zhur. Anal. Khim. 15, 443-5(1960) July-Aug.

The possibility was shown of rather selective and sensitive determination of cerium by means of o-tolidine. Cerium was isolated as oxalate together with lanthanum, as a collector. The oxalates are converted into oxides and are then dissolved in hot concentrated sulfuric acid. The o-tolidine solution was added and the optical density of the obtained yellow solution was measured. The molar extinction coefficient was 9500. The determination of cerium is possible in the presence of thorium, rare-earths, and in the presence of large quantities of iron, aluminum, manganese, and titanium. The method was used for the determination of cerium in apatite, titanite, and monzonite. (auth)

180

PHOTOMETRIC DETERMINATION OF THORIUM IN ROCKS WITH ARSENAZO II. S. B. Savvin, M. P. Volynets, Yu. A. Balashov, and V. V. Bagreev (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Anal. Khim. 15, 446-51(1960) July-Aug. (In Russian)

A photometric method for the determination of thorium (10^{-2} to 10^{-4}%) in rocks with arsenazo II was developed. Two methods recommended for the isolation of thorium are two-fold fluoride and fluoride-oxalate precipitation. The determination by the first method takes 6 to 8 hr, by the second, 24 hr. In both cases the total losses of thorium do not exceed 12 to 14%. (auth)

181

ANALYTICAL CHEMISTRY OF THORIUM. II. COMPLEXOMETRIC DETERMINATION OF THORIUM IN MONAZITE CONCENTRATES AFTER ITS ISOLATION OF THE KY2 CATIONITE. Yu. A. Chernikhov, V. F. Luk'yanov, and A. B. Kozlova. Zhur. Anal. Khim. 15, 452-4 (1960) July-Aug. (In Russian)

A method is suggested for the complexometric determination of thorium in monazite concentrates in the presence of xylenol orange after separation of thorium on the KY-2 cationite. (auth)

182

DETERMINATION OF GAMMA QUANTITIES OF BORON IN COMPLEX ALLOYS. R. B. Golubtsova (Baikov Inst. of Metallurgy, Academy of Sciences, Moscow). Zhur. Anal. Khim. 15, 481-6(1960) July-Aug. (In Russian)

A method is suggested for the determination of γ quantities of boron in a small sample of nickel, cobalt, iron, and titanium-base alloys. The preliminary distillation of boron as methyl-borate is not necessary. The separation of boron from accompanying elements is carried out on the mercury cathode. The optimum conditions were established for the spectrophotometric determination of gamma quantities of boron in various alloys with carminic acid, chromotrope 2B, and arsenazo II. (auth)

183

PHOTOMETRIC DETERMINATION OF STRONTIUM. A. S. Karnaukhov, M. Mizera, and R. Palaush (Higher Pedagogical School, Prague). Zhur. Anal. Khim. 15, 502(1960) July-Aug. (In Russian)

Strontium can be quantitatively determined by means of dilituric acid with the use of a photocolorimeter. If the concentration of strontium in the analyzed solution is less than 1.75 mg/ml, one volume of 0.05 N dilituric acid must be taken for one volume of the analyzed solution. At higher concentrations the quantity of acid for the analysis must be increased correspondingly. When small concentrations are determined the maximum error does not exceed 2%. It decreases with the increase of concentrations. (auth)

184

DETERMINATION OF PHOSPHORUS IN BERYLLIUM OXIDE BY THE SPECTROGRAPHIC METHOD. I. A. Berezin and K. V. Aleksandrovich. Zhur. Anal. Khim. 15, 509-10 (1960) July-Aug. (In Russian)

A spectrographic method for the determination of small amounts of phosphorus in beryllium oxide is described. A broken alternating-current arc is used as the light source. The sample is introduced into the light source on a moving graphite electrode. The sensitivity of the determinations is 0.001%. The reproducibility of the results is ±5 to 6%. (auth)

185

RAPID DETECTION OF FLUORINE IN ORGANIC FLUORINE-CONTAINING SUBSTANCES BY THE NON-WETTABILITY OF GLASS. L. M. Dubnikov and O. V. Chebotarev (Moscow Physico-Technical Inst.). Zhur. Anal. Khim. 15, 511-16(1960) July-Aug. (In Russian)

The possibility was studied of detecting fluorine in small quantities of organic substances of different classes by the non-wettability of glass, applying the method which is used for inorganic fluorides. It was established that the chromium mixture does not break the bond C–F well enough. The attempt to detect fluorine in CF_3COOH and in organic compounds containing fluorine and chlorine by this method was of no success. This method of mineralization gives the possibility of detecting fluorine only in easily mineralized fluorides. From 10 to 20 γ of fluorine in a drop can be detected in fluoranhydrides and in organic substances containing the CFH_2 group. The method was improved by using a solution of $KMnO_4$ in oleum for mineralization of organic compounds. A certain increase of the sensitivity of the detection was achieved. In this case fluorine can be detected even in fluorine and chlorine organic compounds and in compounds containing the CF_3 group. It is possible to detect from 1 γ of fluorine in a drop (for easily mineralized substances) to 10 γ of fluorine in a drop of sparingly mineralized substances (containing the CF_3 group). (auth)

186

POLAROGRAPHIC AND COULOMB STUDIES OF SULFURIC AND PERCHLORIC ACID SOLUTIONS OF URANIUM-(VI). E. A. Kanaevskiĭ and G. R. Pavlovskaya. Zhur. Neorg. Khim. 5, 1964-9(1960) Sept. (In Russian)

The concentration of HSO_4 was found to be the principle factor determining the rate of disproportionation of U(V) in sulfuric acid solutions. Coulomb measurements were made of the number of electrons (Z) participating in uranium reduction at a mercury cathode. For 0.0007 M UO_2SO_4 in 0.05 N H_2SO_4 and 1 N K_2SO_4, Z is 1; in 4 N H_2SO_4, Z is 1.5. The difference in redox addenda number (p–q = 1.4) was determined by the shift of the semi-wave potential

of U(VI) in K_2SO_4 solution, indicating that in the given solution the reduction at a mercury cathode is expressed by $UO_2SO_4 + e^- \rightleftharpoons UO_2^+ + SO_4^{2-}$. (R.V.J.)

187
ADVANCES IN X-RAY ANALYSIS. VOLUME 3. Proceedings of the Eighth Annual Conference on Applications of X-Ray Analysis, Held August 12-14, 1959. William M. Mueller, ed. New York, Plenum Press, 1960. 381p.

Twenty-three papers presented at the Eighth Annual Conference on Applications of X-ray Analysis in 1959 are included. Two papers are also included which were presented at the Seventh Conference in 1958. The papers present information in the fields of x-ray absorption fluorescence, diffraction, and instrumentation. Separate abstracts were prepared for five of the papers. (B.O.G.)

188
THE DIRECT DETERMINATION OF VANADIUM AND NICKEL IN CRUDE OILS BY X-RAY FLUORESCENCE. Victoria R. Lopp and C. G. Claypool (Jersey Production Research Co., Tulsa, Okla.). p.131-7 of "Advances in X-Ray Analysis. Volume 3."

A rapid method was developed for the determination of vanadium and nickel in crude oils in concentrations above 5 ppm. Duplicate analyses for both nickel and vanadium require only 1 hr, and excellent precision is obtained. At a concentration level of 100 ppm of vanadium, the standard deviation is 3.1 ppm, and at a level of 30 ppm of nickel, the standard deviation is 1.6. The results are comparable to those obtained by spectrophotometric and optical emission spectrographic analysis. Conversion of the crude oils to greases by the addition of aluminum stearate minimizes the usual difficulties of handling liquid samples in the conventional-geometry fluorescent x-ray spectrometer. Scattered tungsten emission lines from the x-ray tube serve as internal standards to correct for instrumental and matrix variations. A new sample tray that permits the insertion of four samples into the instrument at a time was constructed. Each sample can be moved into position for analysis without opening the sample chamber, making it necessary to wait for the helium to sweep the trapped air from the x-ray path only once for each four samples. (auth)

189
COULOMETRIC DETERMINATION OF TIN WITH ELECTROLYTICALLY GENERATED IODINE: APPLICATION TO ANALYSIS OF ZIRCALOY. Roy D. Caton, Jr. and Harry Freund (Oregon State Coll., Corvallis). p.207-18 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

Milligram quantities of tin(II) can be titrated with iodine generated electrolytically in a solution of hydrochloric acid and potassium iodide. A method was devised by which the low-level amounts of tin can be reduced to the divalent state prior to titration by passing through a heated antimony reductor column directly into the titration cell. The reduction step is accomplished in 10 min, thus affording a decrease in time over previous methods. The procedure was applied to the determination of tin in Zircaloy, and the weighted standard deviation of 70 analyses was 0.007 mg of tin. Recovery studies made on two alloys and the statistical analysis of a factorial design experiment employing the determination of tin in synthetic Zircaloy solutions with various combinations of nickel, chromium, and iron show that the three metals do not interfere with the determination of tin in Zircaloy. (auth)

General Inorganic and Physical Chemistry

190 AD-234737
New York Univ., New York. Coll. of Engineering.
STUDY OF THE REACTION RATES BETWEEN REFRACTORY OXIDES AND GRAPHITE. Quarterly Progress Report No. 5 [for] September 16, 1959 to March 15, 1960. Kurt L. Komarek and A. Coucoulas. Mar. 1960. 13p. Contract AF33(616)-6082.

A system was constructed to raise and lower the crucible containing the sample magnetically into the preheated furnace while under vacuum. Reaction studies were performed on TiO_2 and reactor-grade graphite (TiO_2/C weight ratio of 2.07/1) at 929, 959, and 1005°C. Reaction studies on Al_2O_3 and graphite (Al_2O_3/C weight ratio of 1.89/1) were performed at 1282 and 1375°C. (See also AD-220420.) (C.J.G.)

191 AERE-M-655
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
SOME PROPERTIES OF PACKED STANDARD PETROLEUM COKE GRISTS. R. H. Knibbs and I. B. Mason. Aug. 1960. 22p. BIS.

Some measurements of the electrical resistivity of compacted beds of standard petroleum coke grist, heated to 2700°C, are described. The use of such measurements to give an indication of the grist calcination temperature is discussed. The pressure-volume relation is also discussed, and a linear relation is demonstrated between grist compressibility and log pressure. (auth)

192 ALI-54
Little (Arthur D.) Inc., Cambridge, Mass.
HALOGEN COLLECTOR TEST PROGRAM. Mar. 1, 1960. 83p. For General Electric Co. Hanford Atomic Products Operation. Contract AT(45-1)-1350, [Sub]contract DDR-68. OTS. (HW-65587)

Efficiency tests of removal of radioactive iodine from an air stream were performed on the following halogen collectors: a silver-plated copper-ribbon bed; activated-charcoal beds, 0.5 and 1.0 in. deep; a molecular-sieve bed; and a sodium thiosulfate bed. The tests were conducted at 70 and 160°F and at 70 and 95% relative humidity. Only the activated-charcoal collectors achieved a high iodine-removal efficiency over a sustained period at the various operating conditions. (C.J.G.)

193 ANL-4159
Argonne National Lab., Ill.
TRITIUM PRODUCTION PROCESS. N. Chellew, J. McGuire, W. Olsen, and A. H. Barnes. May 25, 1948. Decl. Mar. 15, 1960. 25p. Contract W-31-109-eng-38. OTS.

Processes for the separation and purification of tritium from irradiated LiF slugs are described. (J.R.D.)

194 BM-RI-5659
Bureau of Mines.
HEAT OF FORMATION OF YTTRIUM CHLORIDE. R. L. Montgomery and T. D. Hubert. Feb. 1960. 13p.

Heats of solution of YCl_3 and Y_2O_3 in HCl were measured. Using literature data on heat of combustion, the heat of formation of UCl_3 was calculated. This work was performed to check the reported heats of solution of UCl_3 and to determine the heat of solution of U_2O_3. (J.R.D.)

195 DP-470
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.
RECOVERY OF DEGRADED HEAVY WATER AT THE

SAVANNAH RIVER PLANT. William C. Scotten. July 1960. 69p. Contract AT(07-2)-1. OTS.

Information is presented on purification and reconcentration of heavy water at the Savannah River Plant. Process and equipment descriptions, typical operating costs, procedures for control of health hazards, standard analytical methods, and specifications for receipt of degraded heavy water for recovery at the Savannah River Plant are included. (auth)

196 GAT-T-819

Goodyear Atomic Corp., Portsmouth, Ohio.

FLUORINE DISPOSAL USING CHARCOAL. N. W. Houston. July 26, 1960. 12p. Contract AT(33-2)-1. OTS.

Wood, coke, and coconut-shell charcoals were evaluated for fluorine entrapment. The coconut-shell charcoal produced the smallest amount of solid and liquid reaction products. Efficient removal of fluorine was accomplished by the coconut-shell charcoal in a 5-in.-diameter reactor with a feed containing 25% fluorine at flow rates from 100 to 400 scfh and reactor-wall temperatures of 1200 to 1800°F. (C.J.G.)

197 IDO-14517

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

A POTENTIOMETRIC STUDY OF ZIRCONIUM–NITRATE AND ZIRCONIUM–FLUORIDE SYSTEMS. A. J. Moffat. Aug. 18, 1960. 13p. Contract AT(10-1)-205. OTS.

The potentiometric behavior of zirconium in fluoride, nitrate, and fluoride-nitrate systems is correlated and discussed in terms of the zirconium species present. A potentiometric titration was used successfully for the determination of total nitrate and zirconium in aqueous or organic (tributyl phosphate) zirconium-nitrate systems. (auth)

198 LMSD-703150

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

ALUMINUM HYDRIDE — A LITERATURE SURVEY. C. J. Hoffman. Aug. 1960. 23p. OTS.

Unclassified literature on AlH_3 was reviewed. Properties and preparation methods are discussed, and a number of thermodynamic values were estimated for the monomeric form of this compound. (auth)

199 NAA-SR-5066

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THERMAL DIFFUSION OF HYDROGEN IN NONSTOICHIOMETRIC ZIRCONIUM-DIHYDRIDE. A. W. Sommer and W. F. Dennison. Oct. 1, 1960. 33p. Contract AT-11-1-GEN-8. OTS.

The magnitude and direction of the Ludwig-Soret effect in Δ phase ZrH_x at 1000 to 1300°F were measured. The "heat of transport," Q^*, of hydrogen in ZrH_x was determined to be 1.3 ± 0.4 kcal/mole. A mathematical analysis of the kinetics of hydrogen redistribution is presented and shown to compare favorably with experimentally observed results. An observed similarity in the magnitude of Q^* and ΔH, enthalpy of solution, is discussed. (auth)

200 NASA-TN-D-478

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

LUBRICATING PROPERTIES OF SOME BONDED FLUORIDE AND OXIDE COATINGS FOR TEMPERATURE TO 1500°F. Harold E. Sliney. Oct. 1960. 27p. OTS.

Solid-lubricant fluoride and oxide coatings, with good chemical stability in air to at least 1500°F, were formulated. Friction and wear data were obtained with hemispherical specimens sliding at 430 ft/min against rotating disks coated with the experimental lubricants. Several ceramic coatings exhibited moderate friction coefficients (0.3) and prevented severe metal galling and wear. Ceramic-bonded CaF_2 coatings exhibited low friction coefficients (0.06 at 1500°F, 0.12 at 1000°F) as well as good wear protection at elevated temperatures. The relative thermal stabilities of metal halides in air were estimated by thermochemical calculations and checked by x-ray diffraction. (auth)

201 NP-9263

Canada. Dept. of Mines and Technical Surveys. Mines Branch.

SURFACE EXCHANGE REACTIONS OF SILVER AND ITS IONS. J. E. Sandor. Apr. 19, 1960. 25p.

Available as Can. Dept. Mines and Tech. Surveys, Mines Branch Research Rept. R 62. $0.25.

The exchange reactions between silver and its ions in solution were investigated by the use of radioactive tracers. Silver of highest purity was cleaned carefully and immersed in a radioactive silver nitrate solution. The course of the early adsorption process and subsequent diffusion of the ions into the interior of the metal was followed in detail, and the diffusion coefficient at room temperature was calculated. The penetration depth was determined by controlled electropolishing of the metal, and the reverse movement of active ions from the metal into inactive solutions was also observed. (auth)

202 NP-9313

Ohio State Univ. Research Foundation, Columbus.

A MASS SPECTROMETRIC DETERMINATION OF THE HEATS OF SUBLIMATION (OR VAPORIZATION) OF NEODYMIUM, PRASEODYMIUM, GADOLINIUM, TERBIUM, DYSPROSIUM, HOLMIUM, ERBIUM AND LUTETIUM. Technical Report No. 5. David White, Patrick N. Walsh, Harold W. Goldstein, and David F. Dever. Aug. 1960. 38p. RF Project 691. Contract Nonr-495(12).

The heats of sublimation (or vaporization) of Nd, Pr, Gd, Tb, Dy, Ho, Er, and Lu were determined from mass-spectrographic measurements of the metal-ion intensity variations with temperature at fixed electron energies of 20 to 25 ev. The tests were conducted to test the spectrometer sensitivity and to obtain values for use in effusion studies. Data are included. (J.R.D.)

203 ORNL-2988(p.9-44)

Oak Ridge National Lab., Tenn.

HIGH-TEMPERATURE REACTIONS. G. P. Smith, Jr. and R. C. Boston.

Absorption spectra were measured for dilute solutions of bismuth metal in molten $BiCl_3$ over the wave-length, concentration, and temperature ranges 400 to 800 mμ, 0.001 to 0.7 mole/liter, and 237 to 433°C, respectively. A broad, very intense band with maximum at 560 mμ was observed. Apparent Beer's law deviations were large and quite temperature sensitive, indicating a partitioning of bismuth metal into at least two different species in solution. The lowest energy transition ($n \rightarrow \pi^*$) of the nitrate ion was found to shift in a simple way over the series of molten alkali nitrates from $CsNO_3$ through $LiNO_3$. A possible electronic origin of this behavior was considered. Spectral profiles of the molten alkali nitrates were measured at several temperatures, over a wave-length range of about 250 to 360 mμ and with calibrated path lengths down to 19 μ. The profiles consisted of the weak band (II) of the $n \rightarrow \pi^*$ transition, skewed toward high energies and overlapped by an absorption edge. The data, about 50 points per spectrum, were fitted with a least-squares criterion

to several profile models of which the most useful was a Gauss function, symmetrical on a wavelength scale, plus an exponential function. For this profile model, a typical standard deviation was 0.04 liter · $mole^{-1}$ · cm^{-1} for a range of extinction coefficients from 0.06 to 25.5 liters · $mole^{-1}$ · cm^{-1}. The energy E of the maximum of band II varied with the reciprocal of the cationic radius r in an approximately linear way and at 360°C (extrapolated for $CsNO_3$) was represented by the relation E (in electron volts) $\cong 0.03/r + 3.83$. The temperature dependence (dE/dT) was about -10^{-4} ev/deg and increased in magnitude with increasing cationic 1/r. The f number changed by only a small amount from $CsNO_3$ to $RbNO_3$ to KNO_3, all at about 10^{-4}, and then increased to about 1.7×10^{-4} for $NaNO_3$ and to about 4.0×10^{-4} for $LiNO_3$. The thermal coefficient (1/f) (df/dT) was in the range 10^{-4} to 10^{-3} deg^{-1}. The band width changed by only a very small amount for changes either in cation or in temperature. The way in which cohesive forces in a melt can shift a molecule-ion transition was shown by application of the Franck-Condon and conservation-of-energy principles to a localized transition in a classical ionic melt. Additional considerations were invoked to show how Coulomb forces can plausibly account for the observed shift. (auth)

204 TID-6509

Michigan. Univ., Ann Arbor.

THERMODYNAMICS OF THE MONOHYDROGEN DIFLUORIDES. III. HEAT CAPACITIES OF CESIUM, RUBIDIUM, AND THALLIUM MONOHYDROGEN DIFLUORIDES FROM 7 TO 305°K (thesis). Glenn A. Burney and Edgar F. Westrum, Jr. [1960]. 19p. OTS.

Low-temperature heat capacities of $CsHF_2$, $RbHF_2$, and $TlHF_2$ were measured by adiabatic calorimetry, and the thermodynamic functions were calculated from these data. No thermal anomalies were observed over the range studied. The standard entropies of $CsHF_2$, $RbHF_2$, and $TlHF_2$ at 298.15°K are 32.31, 28.70, and 34.92 cal/(deg mole), respectively. The corresponding standard free energy functions $[-(F^\circ - H_0^\circ)/T]$ are 18.22, 15.51, and 20.47 cal/(deg mole), respectively. The entropies of these compounds are correlated with those of other known monohydrogen difluorides. (For Part II see TID-6348.) (auth)

205 TID-6520

Minnesota. Univ., Minneapolis.

CONDENSATION OF STEAM IN STEAM-AIR BUBBLES IMMERSED IN WATER. Ichiro Nishiwaki and Larry A. Klein. Aug. 1960. 46p. Contract AT(11-1)-926. OTS.

Numerical evaluations were made on the condensation of steam-air bubbles in a pool of water. The rate of change in bubble size, partial pressures of steam and air, partial densities, interfacial temperature, mean temperature of bubble, and heat generated by condensation at the interface were calculated for the following initial conditions: initial temperature of bubble, 280°F; bulk water temperature, 100°F; initial bubble radius, 0.25 in.; and pressure on bubble, 18 psia. The effects of initial steam-mass fraction, 0.2, 0.5, and 0.9, and heat-transfer coefficients were included. The conditions selected are applicable to current containment schemes for water-cooled reactors. (auth)

206 TID-6546

Bureau of Mines. Explosives Research Lab., Pittsburgh.

INVESTIGATIONS RELATING TO GAS PHASE DETONATIONS. Final Report. Michael G. Zabetakis and Frank C. Gibson. 42p. Project COWBOY. (BM-LIV-4). OTS.

The proposed use of hydrogen-oxygen mixtures to produce spherical detonations in the Project Cowboy experiments at Winnfield, Louisiana introduces several problems not ordinarily encountered with condensed-phase explosives. These are considered in detail under the sections entitled (1) Gas Handling Systems, (2) Initiating Systems, and (3) Detonation Studies. A gas handling and mixing system for use at Winnfield was designed; a model of the mixer was used in the laboratory. The initiation of spherical detonations was studied at initial pressures as low as $^1/_{16}$ atm.; larger scale tests employed 6-ft diameter balloons at ambient pressure. Detonation velocity measurements were made by using photographic and electronic-probe techniques. Curtailment of the program precluded any gas-detonation tests at the Winnfield site. (auth)

207 AEC-tr-4210

INVESTIGATION OF THE $HF-WO_3-H_2O$ SYSTEM. N. S. Nikolaev (Nikolayev). Translated from Khim. Redkikh Elementov, Akad. Nauk S.S.S.R., Inst. Obshcheĭ i Neorg. Khim. 1, 45-51(1954). 11p. JCL or LC.

The $HF-WO_3-H_2O$ system was investigated by the isothermal-solubility method between 0 and 100% HF at 25°C. Two transformations of tungstic acid were detected: the dehydration and the formation of WF_6. The latter transformation was accompanied by the formation of WF_6 which is insoluble in hydrogen fluoride. (W.L.H.)

208 AEC-tr-4223

ON BISMUTH–IODINE COMPOUNDS. (Über Wismut]–Jodverbindungen). H. S. van Klooster. Translated from Z. anorg. Chem. 80, 104-12(1913). 16p. (Includes original, 9p.). JCL.

The fusion diagram was investigated for the bismuth–iodine system. The tri-iodide of bismuth was prepared, and the melting point was determined. (W.L.H.)

209 AEC-tr-4229

THEORY ON THE STATES OF MATTER. P. P. von Weimarn. Translated for Oak Ridge National Lab. from Z. Chem. u. Ind. Kolloide 2, 199-208(1907-08). 29p. (Includes 4p. of original). JCL.

An investigation was conducted which was aimed at clarifying the inner structure of matter and determining the reciprocal relations of the so-called states of aggregates. Heterogeneous systems such as sols and gels were selected for the starting point, and particle sizes and characteristics were varied arbitrarily. Crystallization phenomena were examined, and it is concluded that an established number of elementary crystalline masses form and disappear in a specified volume depending on the concentration and time. (J.R.D.)

210 AEC-tr-4261

ELECTROCHEMISTRY–MEASUREMENTS OF ELECTROMOTIVE FORCES IN LIQUID AMMONIA. (Électrochimie–Mesures de Forces Électromotrices dans L'Ammoniac Liquide). G. I. Costeanu. Translated from Compt. rend. 195, 778-9(1932). 3p. JCL.

Electromotive forces in liquid ammonia were studied. A formula for the electromotive force in the experimental cell is given, and values obtained at –65 to –35°C are included. (J.R.D.)

211 IG-Inf-Ser-73

THE ALUMINIUM ELECTRODE IN POTENTIOMETRY. E. Scarano. Translated by B. W. Sharpe (U.K.A.E.A., Risley) from Gazz. chim. ital. 88, 1195-1201(1958). 10p.

The effects of pretreatment, presence of O_2, stirring, and solution pH on the electrode potential of aluminum were studied. (C.J.G.)

212

DETERMINATION OF OXYGEN INDEX OF URANIUM OXIDES BY MEANS OF POTASSIUM BICHROMATE EXCESS.

L. Nelman (Chemical and Technological Inst., Prague). Collection Czechoslov. Chem. Communs. 25, 2235-6(1960) Aug. (In Russian)

A new method for the determination of the oxygen index of uranium oxides was perfected. The method depends on the dissolution of the oxide with sulfuric acid in the presence of potassium bichromate and the titration of the excess oxidizing agent. (tr-auth)

213

INVESTIGATION OF HEAT EXPANSION OF α-Sn, InSb, CdTe. S. I. Novikova. Fiz. Tverdogo Tela 2, 2341-4(1960) Sept. (In Russian)

The coefficients of silicon and germanium linear expansion become negative below 120 and 48°K, respectively. Studies were made of the thermal expansion of α Sn which crystallizes into a diamond structure similar to that of silicon and germanium. The coefficient of α Sn linear expansion at temperatures of −130 to 25°C was $\simeq 0.50 \times 10^{-5}$ degree^{-1}. The presence of small amounts of β Sn reduced the absolute value of the negative α value. The ratio α = f(T) for Si, Ge, and α Sn is plotted. The α transition temperature decreases from Si to α Sn. The Si, Ge, and α Sn crystals are covalent. The influence of the bond on the abnormal behavior of the expansion coefficients in relation to temperature was studied with crystals of the isoelectron compounds α Sn, InSb, and CdTe. A small ionic admixture to the covalent bonds was found in InSb and an increasing amount in CdTe. Correlation of the α = f(T) curves for α Sn, InSb, and CdTe shows that with an ionic component in the bond force, the temperature of the α transition to negative values is increased and the absolute magnitude becomes larger; thus it is shown that the region of negative expansion coefficient is present in series of elements and compounds with diamond lattices. (R.V.J.)

214

INFRARED SPECTRA OF URANYL PHOSPHATE, OXALATE, AND SALICYLATE IN THE SOLID STATE. K. V. Narasimham (Madras Inst. of Tech.). Indian J. Phys. 34, 321-30(1960) July.

The infrared spectra of three compounds, uranyl phosphate, uranyl oxalate, and uranyl salicylate, were studied in the region 2 to 24μ using potassium bromide disk and nujol mull methods. About 35 bands in the case of phosphate, 25 in the case of oxalate, and 40 in the case of salicylate were obtained from both these methods. The vibrational frequencies obtained from the infrared work are correlated with those obtained from fluorescence experiments. (auth)

215

ABSOLUTE ISOTOPIC ABUNDANCE RATIO AND THE ATOMIC WEIGHT OF SILVER. William R. Shields, D. Norman Craig, and Vernon H. Dibeler (National Bureau of Standards, Washington, D. C.). J. Am. Chem. Soc. 82, 5033-6(1960) Oct. 5.

An absolute value for the isotopic abundance ratio of natural silver was obtained by the use of isotopic standards prepared from nearly pure separated silver isotopes. Mass spectrometric data resulted in a value for the ratio ($Ag^{107}/Ag^{109} = 1.0754_7 \pm 0.0013$). Within the stated limits, no variation in natural abundance was found among six samples of native silver and commercial silver nitrate. A seventh native silver sample, obtained from Cobalt, Ontario, showed a statistically significant deviation. The calculated physical and chemical atomic weights of silver are 107.9028 ± 0.0013 ($O^{18} = 16$) and 107.8731 ± 0.0020 (O = 16), respectively. On the recently proposed unified physical and chemical atomic weight scale ($C^{12} = 12$), the atomic weight is 107.8685 ± 0.0013. The indicated uncertainties are overall limits of error based on 95% confidence limits for the mean and on allowances for effects of known sources of possible systematic error. (auth)

216

A SIMPLE ISOTENISCOPE AND AN IMPROVED METHOD OF VAPOR PRESSURE MEASUREMENT. Maurice W. Lindauer (Valdosta State Coll., Ga.). J. Chem. Educ. 37, 532-3(1960) Oct.

An apparatus is described which can be used to determine equilibria data for several regions of the zirconium–hydrogen phase diagram. The equilibria data thus found can be used to calculate the heat and free energy of formation of hydrogen in the hydride and solid solution phases, and to check the existing phase diagram. The procedure for determining these equilibria data is outlined and the results are explained. (B.O.G.)

217

ON THE ADSORPTION OF POLONIUM ON CELLULOSE AND GLASS. R. Tauber and T. Schönfeld (Universität, Vienna). J. Chromatog. 4, 222-7(1960) Sept. (In German)

Results are reported of studies on the adsorption of polonium on cellulose and glass. The influence of pH and added salts was especially investigated. The effect of added salts, in particular, indicates that the adsorption of radiocolloidal aggregates must be considered as the essential adsorption mechanism. (auth)

218

FUSED SALT POLAROGRAPHY USING A DROPPING BISMUTH CATHODE. Raymond J. Heus and James J. Egan (Brookhaven National Lab., Upton, N. Y.). J. Electrochem. Soc. 107, 824-8(1960) Oct.

An apparatus that is suitable to study fused chlorides by the polarographic technique is described. Dropping bismuth is used in a way analogous to dropping mercury. Polarographic waves are shown for $PbCl_2$, $ZnCl_2$, and $CdCl_2$ in a LiCl-KCl eutectic melt at 450°C. The method serves as an analytical tool at high temperatures and also yields physicochemical information such as diffusion coefficients by application of the Ilkovic equation. (auth)

219

CATHODIC PROCESSES ON PASSIVE ZIRCONIUM. Robert E. Meyer (Oak Ridge National Lab., Tenn.). J. Electrochem. Soc. 107, 847-53(1960) Oct.

Measurements were made of the rates of reduction of various oxidizing agents on passive zirconium in acid solutions of sodium sulfate at temperatures ranging from 25 to 85°C. The oxidizing agents were oxygen, hydrogen ions, and cupric ions and hydrogen peroxide in the presence of oxygen. The kinetic orders of reduction were determined from potentiostatic experiments in which the current was determined as a function of concentration. Unit and fractional orders were observed with oxygen reduction, and fractional orders from about 0.5 to 0.65 were observed for Cu^{++} and H_2O_2. Possible mechanisms are suggested in which charge transfer through the film is assumed to play a predominant role. (auth)

220

BERYLLIUM FLUORIDES. PART II. FORMATION OF BERYLLIUM FLUORIDES IN SOLUTION. Apurba Kumar Sengupta (University Coll. of Science, Calcutta). J. Indian Chem. Soc. 37, 291-4(1960) May. (In English)

Beryllium is known to be capable of combining with one or more fluoride ions to furnish several simple and complex fluorides. From conductometric titrations of the systems: $Be(NO_3)_2$–KF, BeF_2–KF, BeF_2–HF, and thermo-

metric titration of HF by BeF_2, the existence of the BeF^+ ion, BeF_2 (slightly dissociated), BeF_3^{1-} ion, and of H_2BeF_4 acid was confirmed, but the existence of BeF_3^-, BeF_3^{2-}, or BeF_4^{1-} ions, and of $HBeF_3$ acid could not be corroborated. (auth)

221

POLARIZATION CHARACTERISTICS IN THE ABSORPTION SPECTRA OF URANYL SALTS. K. V. Narasimham and V. Ramakrishna Rao (Andhra Univ., Waltair, India). J. Sci. Ind. Research (India) 19B, 285-301(1960) Aug. (In English)

Polarization characteristics in the absorption spectra taken with single crystals of uranyl acetate, nitrate, and sulfate in different directions were studied at liquid air temperature using a microspectroscopic technique. On the basis of intensity behavior of the bands in the different polarized components, the spectra were classified into different series; this facilitated analysis of the absorption bands. (auth)

222

ULTRA-VIOLET ABSORPTION SPECTRA OF THE MOLECULES H_2O, HDO AND D_2O. W. C. Price (Univ. of London), P. V. Harris, G. H. Beaven, and E. A. Johnson. Nature 188, 45-6(1960) Oct. 1.

The absorption spectra of water down to 185 mμ was observed without finding the fine structure described by Golding. The results were checked on a vacuum grating spectrophotometer and extended down to 180 mμ using silica cells. The absorbance of water rose nearly linearly down to at least 180 mμ with no trace of fine structure. (M.C.G.)

223

A DETERMINATION OF THE MELTING POINT OF ELEMENT 43 (TECHNETIUM). E. Anderson, R. A. Buckley, A. Hellawell, and W. Hume-Rothery (Univ. of Oxford). Nature 188, 48-9(1960) Oct. 1.

The melting point of technetium was determined by melting it under argon in a tungsten tube resistor furnace. The quantity of metal was not sufficient for the direct observation of melting, but after heating to 2150°C the metal had not melted, whereas after heating to 2250°C the powder had melted. Therefore the melting point was taken as 2200 ± 50°C. (M.C.G.)

224

CATALYTIC ACTIVITY OF METALS IN THE ISOTOPIC EXCHANGE REACTION IN MOLECULAR HYDROGEN. M. S. Awdiejenko, G. K. Borieskow, and M. G. Slińko. Nowa Tech. No. 5, 57-73(1959). (In Polish)

The exchange of hydrogen and deuterium in molecular hydrogen, induced by the catalytic action of several metals, was studied by passing a mixture of H_2 and D_2 gas over metallic surfaces. The rate of formation of HD molecules was measured by a thermoconductometric differential method: while a fixed quantity of gas was undergoing exchange by being pumped at a constant rate over the heated metallic surface of the catalyst, a sample of this gas was "borrowed" periodically and sent to a small platinum-wire incandescent chamber where the effective resistance of the glowing platinum wire was determined. This resistance was always compared to that from a standard mixture of unreacted H_2 and D_2 gas with an accuracy approaching 2%. The catalysts were platinum, iron, cobalt, nickel, copper, silver, gold, and a complete range (0 to 100%) of gold-platinum alloys. Several samples each of platinum, nickel, and silver had varying particle size, porosity, and method of preparation. One platinum sample contained SiO_2. The rate of exchange was determined as a function of catalyst temperature, particle size, activation energy of the catalyst, degree of alloying, and electronic structure. The resultant specific catalytic activities, given in micromoles/m^2/sec, were compared. It was concluded that the catalytic mechanism at low temperatures was distinctly different from the mechanism governing the reaction at high temperatures; that the specific catalytic activity is nearly independent of particle geometry, is not a monotonic function of catalyst activation energy, but is principally a function of the electron band structure in the elemental solid, the alloy, or the element plus admixed impurity. (TTT)

225

OPTICAL SPECTRA OF Eu^{2+} AND Gd^{3+} IN CaF_2. W. Low (Hebrew Univ., Jerusalem). Nuovo cimento (10), 17, 607-8(1960) Aug. 16. (In English)

The spectra of Eu^{2+} and Gd^{3+} in a single crystal of CaF_2 were studied. In a crystal containing less than 0.01% gadolinium, sharp but weak lines were observed centered around 32,500 and 37,000 cm^{-1}. In a crystal containing 0.1% europium, sharp absorption bands were found in the region 24,200, 32,300, 35,400, and 37,000 cm^{-1}. There were also diffuse and strong bands centered around 29,000 and 45,050 cm^{-1}. The very weak and sharp lines of the europium spectra seemed to indicate transitions within the f^7 configuration. (M.C.G.)

226

ON MUTUAL INFLUENCE OF ELEMENTS ON THE RADIATION INTENSITY IN THE FLAME. COMMUNICATION 2. COMPOUNDS WHICH ARE FORMED ON EXTINGUISHING CALCIUM AND STRONTIUM RADIATION WITH ALUMINIUM ZIRCONIUM AND URANIUM SALTS. N. S. Poluektov and S. B. Popova (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR, Odessa). Zhur. Anal. Khim. 15, 437-42(1960) July-Aug. (In Russian)

The extinction of calcium and strontium radiation is observed when zirconium and uranium are present simultaneously in the solution, and is not observed when zirconium and uranium are introduced into the flame separately from the solutions of calcium and strontium salts. It is possible to suggest that extinction is connected with the formation of poorly volatile compounds of Ca(Sr) with zirconium and uranium in the moment of evaporation of the solution aerosol beads in the flame. The method of isomolar series permits establishing the composition of the compounds formed in the flame, using the decrease of the radiation intensity of the elements in the flame as a factor characterizing the formation of compounds. The extinction of radiation, when aluminum and zirconium nitrate solutions are used, may be owing to the formation of compounds $Ca(Sr)Al_2O_4$ and $Ca(Sr)ZrO_3$. With calcium and uranium the mixtures of compounds of various compositions are probably formed. With strontium and uranium a compound is formed with the molar ratio of Sr : U = 3 : 2. (auth)

227

HEAT CAPACITY OF CALCIUM AND BARIUM URANATES(VI) AT HIGH TEMPERATURES. V. Ya. Leonidov, T. N. Rezukhina, and I. A. Bereznikova (Moscow State Univ.). Zhur. Fiz. Khim. 34, 1862-5(1960) Aug. (In Russian)

The mean specific heat capacities of calcium monouranate were measured over the temperature range 293 to 1134°K and that of barium monouranate over the temperature range 293 to 1084°K. Equations are presented for calculating the mean and true heat capacities within these temperature

limits. The heat capacity of $CaUO_4$ was shown to change with a jump at the temperature range 1022 to 1027°K. Here a phase transition evidently takes place, the heat of which is 220 cal/mole.

228

AMPHOTERIC PROPERTIES OF YTTERBIUM AND LUTETIUM HYDROXIDES. B. N. Ivanov-Emin and L. A. Nicel'son. Zhur. Neorg. Khim. 5, 1921-3(1960) Sept. (In Russian)

The amphoteric properties of heavy lanthanide hydroxides were demonstrated in the synthesis of ytterbium and lutetium hexahydroxide. Sodium ytterbium and sodium lutetium hexahydroxides were synthesized by heating lanthanide hydroxide with a concentrated solution of caustic soda at 180 to 200°C in an autoclave. The sodium metaytterbiate, $NaYbO_2$, and sodium metalutetiate, $NaLuO_2$, are formed by heating equivalent amounts of the oxides and sodium to 900°C. (R.V.J.)

229

HEAT OF FORMATION OF RuO_2. S. A. Shchukarev and A. N. Ryabov (Leningrad State Univ.). Zhur. Neorg. Khim. 5, 1931-3(1960) Sept. (In Russian)

The heat of formation of RuO_2 was determined calorimetrically to be 73 ± 1 kcal/mol. The heat of formation quoted in published literature is 52.5 kcal. The magnitudes ΔH^0 and S^0 obtained by V. Latimer (The Oxidized State of Elements and Their Potentials in Aqueous Solutions, M. 1954, p.236) are used for determining $\Delta F_{form.\ RuO_2} = -66.6$ kcal. (R.V.J.)

230

THERMODYNAMICS AND KINETICS OF URANIUM OXIDE DISSOLUTION IN ACID MEDIUM. V. I. Spitzyn, G. M. Nesmeyanova, and E. A. Kanevskii. Zhur. Neorg. Khim. 5, 1938-42(1960) Sept. (In Russian)

Isobar potentials for UO_2, UO_3, and U_3O_8 dissolution in sulfuric acid solutions were calculated considering complexing. The magnitudes ΔZ and ΔZ^0 for UO_2 and U_3O_8 are correlated for dissolution in sulfuric acid of 150 to 1000 g/l. The data are in agreement with thermodynamic calculations. The isobar potentials for UO_2, UO_3, and U_3O_8 dissolution in dilute acids show that UO_2 and U_3O_8 demand an oxidizing agent. Correlations of the data on U_3O_8 dissolution with the ordinary redox potentials of corresponding oxidizers reveal no well-defined relation. Kinetic factors determine the dissolution with an oxidizing agent while the temperature effect on oxidation using MnO_2 is relatively small. (R.V.J.)

231

THERMAL STABILITY OF POTASSIUM–ZIRCONIUM FLUORIDES. G. A. Yagodin and V. I. Tarasov. Zhur. Neorg. Khim. 5, 1987-92(1960) Sept. (In Russian)

Thermogravimetric, x-ray-diffraction, and crystallographic analyses were made of the thermal stability of potassium-zirconium fluorides. Five endothermal effects were observed in heating up to 1000°C. At 285 to 330°C the endothermal effects are characterized by a reverse variation in the crystal lattice followed by a crystal deterioration; at 465° the endothermal effect is expressed by potassium-zirconium fluoride decomposition into potassium fluoride and zirconium tetrafluoride; at 600°, the two fluorides begin to melt. The temperatures of these effects depend on the heating condition due to zirconium volatility. Calcining potassium zirconium fluoride in a humid atmosphere for 4 hours at 600°C forms zirconium dioxide. Melting and soaking potassium zirconium fluoride at 800°C in dry argon or hydrogen does not change the chemical and physical properties of the salt. (R.V.J.)

232

DETERMINATION OF HEAT OF FORMATION OF $NbCl_5$. S. A. Shchukarev, M. A. Oranskaya, and T. S. Shemyakina. Zhur. Neorg. Khim. 5, 2135-6(1960) Sept. (In Russian)

The heat of formation of $NbCl_5$ was calculated, considering thermal effects of various reactions, and was determined experimentally. The results show that the enthalpy of $NbCl_5$ is 193.7 ± 0.7 kcal/mol. (R.V.J.)

Radiation Chemistry and Radiochemistry

233 AD-234618

North Carolina State Coll., Raleigh.

INVESTIGATION OF THE EFFECT OF GAMMA RADIATION ON THE VERDET CONSTANT OF SEVERAL SOLUTIONS OF PHOSPHORIC ACID (thesis). George Jerome Kubal. 1960. 78p.

Solutions of H_3PO_4(0.1, 1.0, and 4.0M) were exposed to gamma rays for periods of time resulting in dosages of 10^4, 5×10^4, 10^5, 5×10^5, 10^6, 5×10^6, and 10^7 r. Utilizing magneto-optic rotation equipment, the Verdet constant of each solution was measured after each exposure level. The γ radiations produced a change in the Verdet constant of each solution, the most dilute solution experiencing the greatest change. Tables and graphs of the Verdet constant as a function of gamma dosage are included. An analysis of these data revealed no correlation between the magnitude of the Verdet constant and the amount of radiation. (auth)

234 AERE-M-715

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE IRRADIATION OF SANTOWAX-R WITH FISSION FRAGMENTS. D. A. Landsman and A. E. Truswell. Aug. 1960. 25p. BIS.

Santowax-R was subjected to fission fragment bombardment from thin foils of U_3O_8 at 350°C. An examination was made of the gas produced, the extent of polymerization in the wax, and the fate of the fission products. Experiments were conducted on plating out of fission products. (auth)

235 AFOSR-TN-57-537

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

RADIATION SYNTHESIS OF FLUORINATED AROMATIC COMPOUNDS. Paul Y. Feng and Ljerka Mamula. [1957]. 6p. Contract AF18(603)-121. (AD-136523).

Radiation-induced "cross-halogenations" were observed in reactions of benzene and carbon tetrafluoride in a radiation atmosphere. Product yields were determined and the infrared spectra of the products were studied. (C.J.G.)

236 CF-60-3-8

Oak Ridge National Lab., Tenn.

HYDROGEN EVOLUTION FROM URANIUM-233 PRODUCT SOLUTIONS. R. H. Rainey. Mar. 3, 1960. 9p. OTS.

A graphical method is presented for the calculation of the standard milliliters of hydrogen per hour evolved from solutions of U^{233}. Variation in evolution due to concentration of U^{233}, concentration of U^{232}, and growth of the daughters of U^{232} with time are included. (auth)

237 HW-64305

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

OXYGEN DIFFUSION AND REACTION DURING GAMMA IRRADIATION OF POLYETHYLENE. R. C. Giberson. July 1, 1960. 40p. Contract AT(45-1)-1350. OTS.

A model for the diffusion controlled reaction of oxygen with polyethylene in an irradiation environment is presented. Experimental and calculated results of total oxidation in thin films agree within ~±5% for an exposure range from 5 to 100 × 10^6 r and a sample thickness from 0.0020 to 0.0400 cm. Experimental evaluation of the carbonyl distribution was in qualitative agreement with the theory. The effect of dose rates from 1 to 5 × 10^6 r/hr on the total oxidation and distribution is as predicted by theory. Increased crystallinity was shown to decrease the oxygen penetration and enhance the physical damage to the polymer. (auth)

238 MND-P-2347

Martin Co. Nuclear Div., Baltimore.

FINAL SAFETY ANALYSIS REPORT OF AMERICIUM PROCESSING TO BE PERFORMED BY THE MARTIN COMPANY. John Watcher. May 1960. 66p. Contract AT(30-3)-217. OTS.

A process for purifying Am^{241} and a Heavy Element Processing Facility for the subsequent fabrication of AmO_2–Al elements are described. Features of the facility site in terms of population density, meteorology, geology, hydrology, and aircraft incidents are discussed. Process, monitoring, and safety equipment are listed and described. By a series of ion exchange and precipitation operations, the Am^{241} is reduced to americium oxalate, which is heated to 500°C, converting the oxalate to AmO_2. The AmO_2 is combined with aluminum powder in a ratio of 1 to 26.6 and compacted into aluminum sleeves. The hazards associated with handling americium are a result of α particle emission and pyrophoricity of the element. Radiation hazards due to γ rays and neutrons are considered to be minor. Hazards associated with irradiation of the Am–Al elements and waste disposal are discussed. (C.J.G.)

239 NAS-NS-3014

National Research Council. Committee on Nuclear Science.

THE RADIOCHEMISTRY OF INDIUM. D. N. Sunderman and C. W. Townley, Battelle Memorial Inst. May 1960. 51p. OTS.

Nuclear Science Series of the National Research Council.

240 TID-6186

Stanford Research Inst., Menlo Park, Calif.

RADIATION STABILITY OF ORGANIC LIQUIDS. Semi-Annual Report No. 7 for January 1, 1960–June 30, 1960. L. H. Towle and R. S. Farrand. June 15, 1960. 30p. SRI Project No. SD-2080. For Oak Ridge National National Lab. Subcontract 1081. OTS.

Research was directed toward quantitative determination of the small amounts of dibutyl phosphoric acid (DBP), monobutyl phosphoric acid (MBP), and phosphoric acid (H_3PO_4) that are present in TBP extraction systems that have been irradiated to doses of 40 to 400 whr/liter. An analytical technique was developed that appears satisfactory for the determination of these radiolysis-produced phosphates. The procedure involves the separation of phosphate components by paper chromatography followed by determination of each component by neutron-activation methods. (W.L.H.)

241

BACKGROUNDS FOR LIQUID SCINTILLATION COUNTING OF COLORED SOLUTIONS. R. J. Herberg (Lilly Research Labs., Indianapolis). Anal. Chem. 32, 1468-71(1960) Oct.

It is often difficult or impractical to obtain background solutions of the same color intensity as those of sample solutions. The change of quenching with color is different for isotope and background solutions so that the usual internal standard techniques are not directly applicable. Since the reciprocal absorbance at 400 mμ of colored solutions is a linear function of their relative counting efficiencies, reference of measurements at this wavelength to standard curves permits easy correction of counting rates of colored solutions of different color intensities to the same color intensity. (auth)

242

THE NEW DATA ON THE EFFECT OF RADIOACTIVE RADIATION OF SOLIDS AND THAT OF EXTERNAL RADIATION ON SOME HETEROGENEOUS CHEMICAL PROCESSES. Vikt. I. Spitsyn (Inst. of Physical Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk No. 8, 1325-32(1960) Aug. (In Russian)

New data on the influence of S^{35} emission on the rate of sulfur exchange in $K_2SO_4-SO_3$ and $Na_2SO_4-SO_3$ and of O^{18} in $Na_2SO_4-O_2^{18}$ at elevated temperatures show that external bombardment with high-energy electrons affects the isotopic exchange rate only at doses higher than the radioactive radiation. High-energy electron and proton bombardments inhibit barium sulfate sorption of organic dyes. The same effect was observed during continuous S^{35} β decay. Potassium sulfates containing S^{35} absorb more methyl alcohol vapor than nonradioactive K_2SO_4. The radioactive emission affects the solubility processes and the solubility of slightly soluble substances. (R.V.J.)

243

THE RADIATION INDUCED cis-trans ISOMERIZATION OF POLYBUTADIENE. [PART] III. Morton A. Golub (B. F. Goodrich Co. Research Center, Brecksville, Ohio). J. Am. Chem. Soc. 82, 5093-8(1960) Oct. 5.

A study was made of the γ-ray induced cis-trans isomerization of polybutadiene in solution and in the solid state in the absence of any deliberately added sensitizer. Starting with an essentially all-cis or all-trans polybutadiene, the unsensitized isomerization approached a radiostationary equilibrium in which the cis/trans ratio in the polymer was about 20/80, in contrast to the thermodynamic equilibrium ratio of 8/92 obtained in previous sensitized isomerizations of polybutadiene. The unsensitized reaction was first order in cis (or trans) content with a rate that was proportional to the radiation intensity. The isomerization in a 1% solution in benzene was about eight times as fast as that in the pure polymer. The G_0 values for the cis → trans reaction (i.e., the number of cis double bonds initially converted to trans per 100 ev of energy absorbed by the polymer and the solvent in the solution case and by the polymer alone in the solid state case) are about 1.2 and 14.6, respectively. The corresponding G_0' values for the trans → cis reaction are about 0.3 and 3.6, respectively. The mechanism of the unsensitized isomerization is believed to involve excitation of the π electrons of the polymer double bonds to an antibonding state where free rotation, and hence geometric interconversion, can occur. This excitation in the solid state presumably results from collisions of energetic electrons with the polymer molecules. The double bond electrons are excited directly and/or indirectly through intramolecular energy transfer from the methylenic groups in the polymer. These processes occur also in solution but are less important there than intermolecular energy transfer from excited or ionized solvent molecules to the polymer double bonds. (auth)

244

FORMATION OF KETENEIMINE STRUCTURES DURING

POLYMERIZATION OF ACRYLONITRILE WITH X-RAYS. Catherine S. H. Chen, Norman Colthup, William Deichert, and Richard L. Webb (American Cyanamid Co., Stamford, Conn.). J. Polymer Sci. 45, 247-8(1960) July.

Evidence was found of a keteneimine type structure, (–C=C=N–), in polymers prepared by x irradiation of pure liquid acrylonitrile at −78.5°C. A distinctive infrared band was found at 2030 cm^{-1}. When a sample was heated for several hours at 100° in acidified water, the 2030 cm^{-1} band disappeared completely, and the intensities of the 1675 and 1525 cm^{-1} bands increased. This was consistent with the action of a monosubstituted amide. The distinctive infrared band and chemical reaction indicated the presence of the keteneimine structure. (M.C.G.)

245

γ-RADIATION-INDUCED POLYMERIZATION OF STYRENE. R. H. Wiley and M. T. Lipscomb (Univ. of Louisville, Ky.). J. Polymer Sci. 45, 271-4(1960) July.

A study of the γ-radiation-induced polymerization of styrene at 2.0 to 5.0 rep/hr established rates of polymerization of 0.7 to 1.44%/hr with rates dependent on the 0.85 power of the intensity. The rates were determined by polymer isolation and change in refractive index. (auth)

246

ROLE OF FERROUS HYDRIDE IN THE OXIDATION OF FERROUS ION BY HYDROGEN ATOMS. G. Czapski and J. Jortner (Hebrew Univ., Jerusalem). Nature 188, 50-1 (1960) Oct. 1.

Nitrous oxide was used to discriminate between the various forms of hydrogen atoms in the radiation-chemical oxidation of ferrous ions by atomic hydrogen. Results indicated that in the pH region up to 2 the reaction proceeded by hydride ion formation ($Fe^{2+} + H \rightleftharpoons FeH^{2+}$ and $FeH^{2+} + H^+ \rightarrow Fe^{3+} + H_2$). (M.C.G.)

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IRRADIATION OF ORGANIC LOW MOLECULAR COMPOUNDS BY COBALT-60 GAMMA-RADIATION. II. POLYMERIZATION OF STYRENE. Motome Hamashima. Tokyo Kôgyô Shikensho Hôkoku 55, 223-9(1960) July. (In Japanese)

Irradiations of organic compounds were performed with a Co^{60} source of about 200 curies. Polymerization of styrene was studied with an additive by the irradiation of gamma rays at room temperature in vacuo. A value of acceleration efficiency R_E ($R_E = R_P \times R_M$, where R_P is the ratio of the polymerization rates and R_M is that of the viscosity average molecular weights of the polymer with and without an additive in the same experimental condition) was obtained from the result of the polymerization reaction, and it was disclosed that the value depended largely on the kind of the additive. An additive that had two functional groups in the molecule was added to styrene monomer in a concentration of 0.1 mole/liter. If the additive had a halogen and a hydroxyl group, only the latter would show an effect on the value of R_E, whether it is an aliphatic or an aromatic compound. An additive that had a functional group in the molecule was added to styrene monomer in the concentration range of 0.02 to 0.2 mole/liter. Both the values of R_P and R_M changed with the concentration of the additive, but the value of R_E remained almost constant and independent of the concentration change of the additive except in case of nitrobenzene. The values of chain transfer constant of the additives are also calculated. (auth)

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RADIOLYSIS IN THE ADSORBED STATE. J. W. Sutherland and A. O. Allen (Brookhaven National Lab., Upton, N. Y.). p.3-15 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

The radiolysis of pentane adsorbed on mineral solids was investigated. Extensive blanks were run to show that the observed decompositions result only when the pentane and solid are irradiated together. High product yields do not arise from an activation of the solid by the radiation, followed by catalytic decomposition of the pentane. Rather, a transfer of energy occurs during irradiation. The radiolysis of pentane occluded within the crystal lattice of dehydrated synthetic zeolites (Linde Molecular Sieves 13X and 5A) was studied. For the sodium zeolite 13X, the hydrogen yield (the quantity of hydrogen produced per unit energy input to the entire system of solid plus pentane) varies but little with the amount of pentane present, as though the radiation energy were pooled and resulted in decomposition with efficiency independent of the amount of pentane present. The yield is small, G = 0.32–0.4, at 2 to 17% pentane in the zeolite. Partial replacement of the sodium ions in the zeolite with manganous ions lowered the hydrogen yield, but with cobaltous ions the yield increased many fold. Caffrey's high values for hydrogen yield from radiolysis of pentane on silica gel were confirmed and the finding that at low percentages of pentane a large yield of branched hydrocarbon, notably isopentane and isobutane, results. At higher percentages of pentane (5 to 13%) these branched products no longer appear, but the higher hydrocarbons from hexane to decane occur, and the course of the radiolysis seems to resemble that of liquid pentane, with energy from the silica gel contributing. The isomerization reactions occur only at low coverages, when the pentane molecules are more nearly isolated from one another. (auth)

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GAMMA-RADIATION-INDUCED PEROXIDATION OF CERTAIN HYDROCARBONS. M. Durup, J. Durup, and M. Magat (Faculté des Sciences, Paris). p.17-27 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In French)

Chain oxidation of hydrocarbons becomes possible at various fairly high temperatures, depending on their structure. If the process is initiated by ionizing radiation, which is independent of temperature, it is frequently possible to select a temperature at which peroxidation takes place at an adequate speed but secondary reactions, such as decomposition of the peroxides formed, remain negligible. The reaction can be further accelerated by adding certain substances. This aspect of peroxidation is discussed taking cumene as an example. The prospects for industrial application are reviewed. Where chain oxidation does not take place, mainly diperoxides are formed, which are difficult to obtain by purely chemical processes. As an illustration, the peroxidation of iso-octane is considered. The employment of polymer peroxidation under various conditions for the preparation of grafted polymers of various structures is discussed. (auth)

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RADIOCHEMICAL OXIDATION OF HYDROCARBONS. Roger Montarnal and Monique Brun (Centre d'Etudes Nucléaires, Grenoble, France). p.29-50 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In French)

The use of radiation represents a method of initiating radical chain reactions and, in particular, the oxidation of liquid phase hydrocarbons by molecular oxygen. The following paper describes an apparatus for carrying out this work using 200 kv x rays. It then gives results obtained for oxidation of olefines and paraffins and from study of the stability under irradiation of the peroxides obtained. In the case of olefinic hydrocarbons, kinetic study made it possible to determine the fundamental characteristics of the cyclohexene and diisobutylene oxidation chain reaction: $\sqrt{I}$ law, total G count, radical G count, length of chain, and energy of activation. The effect of homogeneous (CCl_4), or heterogeneous (ZnO) sensitizers was studied. In the case of saturated hydrocarbons, the obstacles in the way of a thorough study are more serious in that the propagation constant of the oxidation chain is weaker than with certain olefines; the researcher may have to operate at a temperature at which the oxidation products decompose and contribute to initiation. In the case of cetane and cyclohexane, it was possible to define the most favorable temperature ranges and to identify a number of characteristics of the oxidation reactions. Finally, a study was made of the stability of certain hydroperoxides under irradiation. (auth)

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USE OF FISSION PRODUCTS IN A PILOT SET-UP TO INITIATE THE OXIDATION OF PARAFFIN. G. Ioanid, A. Dragut, J. Drimus, V. Dumitresco, and I. Stoian. p.51-9 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In French)

Previous publications have laid down the optimum laboratory conditions for initiating the oxidation of paraffin by using a Co^{60} source of 50 g Ra equivalent. The research described here concerned the use of large radiation sources (fission products from the nuclear reactor) in a pilot set-up. The presentation includes: a description of the set-up for the irradiation of paraffin without airbubbling; the results relating to the oxidation of preirradiated paraffin; and the optimum working conditions for the source used and data on the doses absorbed in the course of the experiments. (auth)

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A COMPARISON OF THE PRODUCTION OF THE INSECTICIDE "GAMMEXANE" (1:2:3:4:5:6-HEXACHLOROCYCLOHEXANE) BY ULTRA-VIOLET AND Co^{60} GAMMA RADIATION. P. R. Hills, R. Roberts, and M. W. Spindler (Atomic Energy Research Establishment, Wantage, Berks, Eng.). p.61-79 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

A comparative study was made of the synthesis of the gamma-isomer of 1:2:3:4:5:6-hexachlorocyclohexane "Gammexane," both by ultraviolet and Co^{60} gamma-radiation. Experiments with light of wave length 3,650 A, employing a variety of experimental conditions, have established an optimum quantum yield of 8.67×10^3 for the production of the hexachloro compound which contains $13.2 \pm 1.3\%$ of the gamma-isomer. The introduction of additives did not improve either the gamma or gamma-isomer yield. For radiation initiated experiments the "Gammexane" content is $15.3 \pm 1.6\%$ and is independent of dose rate, benzene concentration, and duration of the chlorination process. Reaction at low temperatures effects small improvements in the gamma-isomer yield. A comparison of both methods of initiation shows that the absorbed energy is utilized with equal efficiency in each case. (auth)

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RADIOCHEMICAL CHLORINATION OF A CARBON CHAIN LINKED TO A COO-GROUP. PROPIONIC ACID AND SOME DERIVATIVES. Ph. Traynard and P. Verrier ([Centre d'Etudes Nucléaires, Grenoble, France]). p.81-95 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In French)

Under the effect of ionizing radiations, chlorine dissolved to saturation point in one of these liquid compounds is substituted for a hydrogen atom in the carbon chain. As in the case of photolysis, it is a radical reaction and subject to a chain process. The radicals derive from the radiolytic decomposition of the liquid medium and the chlorine is the chain propagating agent. This chain, which is particularly long, produces a very high real G-value, which varies with the radiation intensity and may exceed 10^5. Thus the reaction is economically profitable and might be put to industrial use, as the monochloro- or dichloropropylic acids or esters yield corresponding acrylic derivatives. Under low intensity radiation, the initial speed of the reaction is proportional to the square root of this parameter, but as the intensity increases the initial speed tends to become independent of this factor. Chlorination may be taken to the final stage of substitution of the five H atoms in the carbon chain and even to the pentachloropropionic acid chloride stage, yielding a range of perfectly reproducible and often crystallizable substances. (auth)

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SOME INDUSTRIAL ASPECTS OF RADIATION-INDUCED CHLORINATION REACTIONS. Irving Rosen (Diamond Alkali Co., Painesville, Ohio). p.97-110 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

Considerations of basic economics and of process conditions show that the costs of chlorination products from long chain free radical reactions will not be reduced by substitution of fission product energies for conventional initiator energies. For large radiation sources to be commercially attractive, they should offer a means to good yields of chlorination products which cannot be obtained with conventional photo-initiators. In 1954, the first reports appeared which described products obtained from the gamma radiation-induced chlorination of toluene as being markedly different from those obtained by conventional free-radical chlorination initiators. To clarify those reports, a comparison was made of the gamma and ultraviolet radiation-induced chlorinations of toluene and butyric acid. Toluene was chlorinated in the presence of ultraviolet light at 15°C to give a hexachlore addition product similar to that reported in the literature from gamma initiation. Butyric acid was chlorinated in the presence of gamma radiation to give chlorobutyric acid isomer mixtures which were about the same as those reported in the literature from ultraviolet initiation. These results suggest that gamma radiation has about the same effect as photoinitiation on the course of aliphatic substitution and additional chain chlorination reactions, and acts merely as a free radical initiator. The recently reported results of other workers on free radical radiation-induced halogenations and sulfochlorinations also support this conclusion. The future use of large radiation sources for chlorination reactions depends upon, and still awaits, the development of unique applications and products. (auth)

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RADIATION DAMAGE TO SOLIDS AND CATALYSTS. John

Turkevich (Princeton Univ., N. J.). p.111-17 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

A review is given of the numerous attempts to alter the catalytic activity of solids by exposure to nuclear radiation. The results obtained are interpreted in terms of studies on the radiation damage to zinc sulfide and the catalytic activity of charcoal. The first system studied was that of the zinc sulfide phosphor. The change in the many luminescent properties of this material on neutron damage gives evidence as to the nature of the damage centers produced in the solid. These results are used to interpret the effects of radiation damage on the catalytic properties of solids. A graded set of charcoals produced by varying thermal treatment was characterized for catalytic activity by the study of the ortho para hydrogen conversion and the hydrogen-deuterium exchange. This set was studied by electron spin resonance techniques. The results obtained are shown to have important implications in the question of how radiation damage affects the catalytic activity of solids. (auth)

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THE USE OF IONIZING RADIATION IN HETEROGENEOUS CATALYSIS. Ellison H. Taylor, Harold W. Kohn, and George E. Moore (Oak Ridge National Lab., Tenn.). p.119-30 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

Two recent developments have aroused interest in irradiating heterogeneous catalysts. The first is the gradual incorporation of ideas from solid-state physics into catalytic theory, and the realization that some of the point defects produced by ionizing radiation are likely to influence catalytic properties. The second is the availability of large radiation sources, offering the possibility of rapid production of defects, and, more remotely of making practical improvements in catalysts. There is evidence that major alterations in catalytic activity can be produced by ionizing radiation, and the changes that were observed are varied enough to suggest further exploration. Thus, the activity of zinc oxide for hydrogenation of ethylene is reduced by irradiation with gamma rays, while its activity for hydrogen deuterium exchange is increased. The activity of gamma-alumina for the latter reaction is increased by gamma irradiation, but the increase depends upon previous poisoning of the catalyst. Remarkably large increases for the same reaction occur upon irradiation of silica gel, but here prior poisoning is unnecessary. It is hoped that such observations may help to define those features of solids which are responsible for the activity of ordinary catalysts. It is known, for instance, that lattice vacancies, interstitial atoms, and trapped electrons are produced by radiation, and it should be useful to be able to define the role of these defects in catalysis. Prospects for application of radiation for the improvement of catalysts are rather remote, principally because most of the effects disappear on heating to the temperature range of most commercial processes. A related possibility for practical application, the irradiation of a substrate in the presence of a solid surface, was suggested by others and may depend upon related phenomena. (auth)

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THE PROSPECTS FOR THE INDUSTRIAL USE OF RADIATION-THERMAL CRACKING OF NORMAL HYDROCARBONS. A. V. Topchiev, L. S. Polak, N. Ya. (Y.) Chernyak, V. E. Glushnev, I. V. Vereshchinskiĭ (Vereshchinsky), and P. Ya. (Y.) Glazunov (Academy of Sciences, Moscow). p.131-8 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In Russian)

Experimental research has shown that, in radiation-thermal cracking (RTC), the radiation produces reaction-initiating centers while the temperature (200 to 300°C lower than normal thermal cracking temperatures) eliminates the activation barriers which inhibit chain growth. By an appropriate choice of dose rate, dose interval, and temperature, it is possible to control the process so as to obtain a significant increase in the yield of unsaturated compounds and significant amounts of molecular hydrogen. An effect associated with the RTC process is the formation of noticeable amounts of methane and other low-molecular alkanes. It was shown that under appropriate conditions, yields of the order of 10^3 molecules are obtained at 100 ev with a 2 to 4 minute irradiation of the alkane in the gaseous (vapor) phase. With longer exposure times, secondary processes resulting not only from the reactions taking place in the zone of irradiation of the RTC products but from their protective radiochemical effect, are observed in the composition of the RTC products. In the linear zone, the exposures quoted yield a 10 to 20% conversion of the initial substance. As the temperature increases, the composition of the RTC products approaches more and more closely those of ordinary thermal cracking products. Preliminary calculations are given and possible features of industrial RTC processing are discussed. (auth)

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PREPARATIVE RADIATION CHEMISTRY: NEW SYNTHESES OF DICHLORO-PHOSPHINES AND NITROSO-COMPOUNDS. Arnim Henglein (Mellon Inst., Pittsburgh). p.139-47 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

Intense high energy electron beams were used to synthesize new compounds in preparations which are considerably more convenient than conventional methods. The reactions studied may be classified in either of two principal categories: those in which the product is formed by combination of free radicals from the radiolysis of different components of a mixture ("combination reactions") and those in which radicals react with a scavenger present at low concentration and which has to be continuously delivered to the system during irradiation ("scavenging reactions"). Dichlorophosphines can be directly synthesized from phosphorus trichloride and aliphatic, olefinic, and aromatic hydrocarbons. The reaction proceeds via a combination mechanism. The yields amount to about 50% of the reacted material at a conversion of 25%. The by-products are mainly hydrogen chloride and undistillable residues and only small amounts of organic chlorides, phosphorus tetrachloride, and higher hydrocarbons. In the case of olefins radiation yields of up to 12 molecules per 100 ev of absorbed energy were observed for the total consumption of phosphorus trichloride and hydrocarbon. The double bond is not affected and the PCl_2 group is directed mainly into the alpha position. Values for G of 5 to 7 were observed in mixtures with aliphatic hydrocarbons and somewhat smaller yields in the case of aromatic compounds. Some other chlorides react with hydrocarbons in a similar way. For instance, in mixtures of phosphorus oxychloride and hydrocarbons phosphine oxides are formed. Nitric oxide acts as

a radical scavenger in organic liquids. New nitroso compounds may be synthesized by the addition of free radicals to nitric oxide. In CCl_4-NO mixtures trichloro-nitroso-methane is formed. Dichloro-nitroso-methane, which was not previously synthesized is formed in $CHCl_3$-NO mixtures. A polymer is produced in PCl_3-NO mixtures, probably by polymerization of the intermediate dichloro-nitroso-phosphine. (auth)

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RADIOCHEMICAL SYNTHESIS OF COLORANTS. F. Balestic (Commissariat à l'Énergie Atomique, Saclay, France) and M. Magat. p.149-63 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In French)

Some dye syntheses were performed experimentally under radiation, in particular, that of thionine. A hydrochloric solution of p-phenylene diamine was irradiated in the presence of $CuSO_4$ and $S(NH_4)_2$ with different pH values. Under acid conditions, the thionine formed was distinguished by its absorption spectrum in visible light. The dye was isolated by bringing the irradiated mixture to an alkaline pH value and extracting with chloroform, then passing the extract over an alumina column and washing with ethanol. Various characteristic dyeing reactions were then carried out on the product. A kinetic study of the reaction was carried out. The following were investigated: the form in which the sulfur should be introduced; the part played by oxygen; the participation of hydroxyl radicals and hydrogen atoms in the reaction; and the influence of the various physical factors, such as dosage and intensity of irradiation, energy of radiation, and temperature. It seems that the reaction yield may reach 2. (auth)

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THE EFFECTS OF NUCLEAR RADIATION ON COAL AND METHANATION REACTIONS. Ernest J. Henley (Stevens Inst. of Tech., Hoboken, N. J.). p.165-76 of "Large Radiation Sources in Industry. Conference Proceedings Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

A model compound, anthracene, was selected for initial study. Attempts to lower the threshold temperature for cracking or methanation by use of radiation were unsuccessful. Methanation runs at hydrogen pressures between 1000 and 1800 psig and temperatures of 850 to 860°F showed a marked susceptibility to radiation catalysis. G values of about 700 to 900 were obtained. Of forty runs made, seventeen were made in a 43,000 r/hr gamma radiation field. A number of experiments with high temperature coke and anthracite were undertaken, which were generally unfruitful. It was found that radiation would not lower the threshold methanation temperature. Hydrogenation of a retorted, high volatile, Illinois B-bituminus coal was accomplished in and out of radiation fields. Radiation had no effect on the rate of methane formation for the seventeen runs at 950 to 960°F and pressures of 800 to 1800 psig. Unless specifically stated, retorted, Illinois B-bituminous coal was used for all runs. A number of catalysts were investigated. Ammonium molybdate, ferrous sulfate, fluorescent powder, zinc sulfide, and lead were without effect on the rate of methane production at 950 to 960°F and hydrogen pressures of 800 to 1400 psig. Stannous chloride, calcium hydride, sodium borohydride, and sodium increased the rate of methane formation from 1.5 to 3-fold. Radiation did not enhance these catalytic effects. Fifty-four runs were made on the char-water systems at temperatures of 1180 to 1200°F, and pressures of 1900 to 2500 psig. Twenty-five of these runs were carried out under irradiation fields of 52,200 r/hr. Atomic radiation greatly increased the rate of methane formation, G values of 1500 to 3340 being obtained. These runs were repeated in the Brookhaven National Laboratory's gamma pool. At a dose rate of 174,000 r/hr, ten runs gave an average G value of 1500. The kinetics and mechanisms of the reactions are discussed. (auth)

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CHEMONUCLEAR REACTORS FOR IN-PILE PROCESS IRRADIATION. L. S. Mims (Atomics International, Canoga Park, Calif.). p.357-61 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

The potential economic incentive for the utilization of nuclear reactors for in-pile irradiation of process streams is discussed. It is assumed that a dual fluid reactor for in-pile irradiation can be constructed and operated for approximately the same cost per thermal kilowatt, as a single fluid reactor for production of steam for industrial heating. According to a recent study, the cost of thermal energy from nuclear reactors of the pressurized water, boiling water, and organic-cooled types is approximately U.S. $1.00 per million BTU for units of the order of 40 Mw(t). On this basis it is estimated that 80,000 lbs of material may be irradiated with 10 megarads for about U.S. $100.00. A dual flow organic-cooled reactor is selected for this study. An attempt is made to establish the economic possibility and typical features of this type of chemonuclear reactor. (auth)

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ELEMENTARY PROCESSES CHARACTERISTIC OF RADIATION CHEMISTRY AND POSSIBLE INDUSTRIAL IMPLICATIONS. Milton Burton (Univ. of Notre Dame, Ind.). p.425-36 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." Vienna, International Atomic Energy Agency, 1960. (In English)

Elementary physical and chemical processes particularly characteristic of radiation chemistry explain some of the observed differences between such chemistry and the older and more conventional branches, and give promise of possible new industrial developments. Some of the more obvious differences (e.g., in possible intensity of energy input at low temperature) may have special technological significance for gases as well as for condensed systems. Only elementary processes unique to radiation chemistry and their special implications are treated here. Most outstanding of these processes are ionization and the decomposition reactions of ions. In gases particularly, reactions of molecules with positive or negative ions may play a new and important industrial role. The effect of pressure in pure gases and gaseous mixtures is yet to be explored from this viewpoint. In liquids and other condensed systems (and sometimes in gases at high pressure), the special differences between radiation chemistry and other branches of kinetics are emphasized and exaggerated by the local microscopic distribution of primary effects in ionization columns and in spurs. In addition to the possibilities of reactions involving ions and neutralization of ions, considerations are given for: ionization and excitation transfer, rapid internal conversion processes, the role of metastable (e.g., triplet) excited states, Stern-Volmer reactions of excited molecules, reactions of excited molecules with each other, and diffusion controlled processes involving four or more radicals. Industrial applications of radiation chemis-

try are an obvious result of the exploitation of such unique elementary processes not only at high temperatures but perhaps particularly at very low ones. (auth)

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IMPROVEMENTS IN OR RELATING TO THE COATING OF ORGANIC POLYMER SUBSTRATES. (to E. I. Du Pont de Nemours & Co.). British Patent 839,483. June 29, 1960.

A method is outlined for applying organic coatings to polymer substrates without affecting the bulk physical properties of the substrate and consists of irradiating the surface in the absence of O_2 and then, while the effects of the irradiation are still active, bringing the surface into contact with a dissimilar organic compound to form a coating on the surface. The radiation usually is electrons with energy from 15 ev to 50 kev used for a minimum exposure of 10^{-2} watt-sec/cm^2, and the time between irradiation and contacting preferably is short and not over 5 min, although lower irradiation temperatures enable longer storage times to be used. The substrate usually is any natural or synthetic solid polymer with a molecular weight >500, while the coating material may be any dissimilar compound applied in the form of gas, liquid, or solid (the latter by sublimation or melting). The advantage of this coating method is that coatings of nonpolymerizable as well as polymerizable materials can be formed. Two examples of this method are given in which regenerated cellulose and polyethylene films are coated with polyvinylidene chloride and grafted acrylic acid, respectively. (D.L.C.)

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IMPROVEMENTS IN OR RELATING TO THE GRAFTING OF POLYMERS TO CELLULOSE SUBSTRATES. (to E. I. Du Pont de Nemours & Co.). British Patent 845,690. Aug. 24, 1960.

The efficiency of radiation in graft polymerization of unsaturated monomers on cellulose-base materials (substrates) may be increased by swelling the substrate with a water-soluble, nonpolymerizable swelling agent prior to irradiation. Acids, bases, and salts, as well as water, can be used as swelling agents, and they should be incorporated in the substrate to at least 15%. Irradiation should be carried out to at least 10^{-3} watt-sec/cm^2 with ionizing radiation of an energy at least equivalent to 0.1-Mev electron beam, and application of the monomer to the substrate should take place while the substrate is still active from irradiation. After the graft polymerization, the swelling agent may be removed together with ungrafted monomer by solvent extraction. Four examples of the method are given using NaOH and HCl solutions as swelling agents and vinyl acetate, vinylidene chloride, and acrylonitrile as monomers. Data on the treatment of cellulosic substrates with a wide variety of monomers are also presented. (D.L.C.)

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IMPROVEMENTS RELATING TO POLYOLEFINS. (to General Electric Co.). British Patent 849,042. Sept. 21, 1960.

Solid polypropylene and polyethylene may be cross-linked effectively by irradiation in the presence of a chlorobenzene, the effect of chlorobenzene being more marked with polypropylene which is normally difficult to cross-link. The form of the polymer to be irradiated may be either polymer swollen with chlorobenzene or a solution of polymer in chlorobenzene; whatever the form, it should be 50 to 80% chlorobenzene. Dichlorobenzenes and polychlorobenzenes can also be used. The radiation should be of energy 0.1 to 10 Mev and used in doses from 1 to 50×10^6 rep. Several experiments were performed on polypropylene and polyethylene with several solvents and chlorobenzenes for comparison, using 0.8-Mev electrons and varying doses. The cross-linking method may also be applied to filled polymers. (D.L.C.)

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IMPROVEMENTS IN PROCESSES FOR GRAFTING ON POLYMERS. (to Societe des Usines Chimiques Rhone-Poulenc). British Patent 850,446. Oct. 5, 1960.

Polymers may be coated with radioinduced graft polymerization films by conducting the irradiation with the polymer in a gaseous phase composed of a mixture of the polymerizable monomer and a softening agent to increase the degree of grafting. This method of grafting is generally applicable to polymers of all kinds and unsaturated polymerizable monomers, and a list of such polymers and monomers is given. Eleven examples of this method are given in which glycol polyterephthalate, polyvinyl alcohol, and cellulose acetate are used as the base polymer; vinyl acetate, acrylonitrile, vinylmethyldichlorosilane, and methyl methacrylate are used as the monomer; and water, methylethyl ketone, alcohol, and benzene are used as softening agents. (D.L.C.)

Raw Materials and Feed Materials

267 TID-6422

Michigan Chemical Corp., St. Louis, Mich.

EVALUATION OF XENOTIME ORE AS A SOURCE OF FEED FOR THE RARE EARTH PLANT. Report 114. Period covered: July 26, 1956 to September 3, 1957. John R. Morton. Nov. 12, 1957. Decl. Feb. 6, 1959. 4p. Project 942. OTS.

Xenotime ore was cracked with sulfuric acid. The difficulty encountered in cracking the ore can probably be overcome by finer grinding and higher digestion temperatures. The uranium content was removed in anion exchange columns. Of the total material recovered from the columns, 15.0% was recovered as 95% Y_2O_3, 25.7% was recovered as 99% Y_2O_3, 2.5% was recovered as 99.9% Y_2O_3 and 4.3% was recovered as high purity yttrium oxide. (auth)

268 TID-6435

Michigan Chemical Corp., St. Louis, Mich.

PILOT PLANT EVALUATION OF A MALLINCKRODT YTTRIUM CONCENTRATE AS RARE EARTH PLANT FEED. Period [covered]: April 15, 1957 to July 23, 1957. Report 100. John R. Morton. Aug. 31, 1957. Decl. Feb. 6, 1959. 2p. Project No. 926. OTS.

An yttrium concentrate in the form of a wet hydrous oxide was evaluated in pilot-plant studies as a rare earth plant feed. No high-purity material was produced owing to the very short band length used. (C.J.G.)

269 TID-6635

Oak Ridge Gaseous Diffusion Plant, Tenn.

A SMALL-SCALE URANIUM HEXAFLUORIDE PLANT. S. H. Smiley. Dec. 11, 1959. 6p. (KL-651). OTS.

Design and construction information on a facility to convert 25 tons per year of uranium-ore concentrate to UF_6 are given. Process technology is included, and data on project scheduling and daily operating costs are tabulated. (J.R.D.)

270 CEA-tr-X-198

TRAITEMENT DES MINERAIS D'URANIUM. III. (Processing Uranium Ore. [Part] III). J. Beranek and F. Holub. Translated into French from Jaderná energie 4, 93-8(1958). 22p.

A pilot-plant design is described for treatment of uranium ores. The plant is actually under construction in

Czechoslovakia. The possible variations in the technological processes are pointed out. After description of the process chosen, the equipment and materials used are discussed. The health and safety of workers handling uranium are also discussed. The process involves an H_2SO_4 leach, 5 ion exchange columns, Na_2CO_3 precipitation, and purification of phosphate, and reduction of diuranate to metal. (T.R.H.)

271

PROCESS FOR PREPARING URANIUM TETRAFLUORIDE. (to Mitsubishi Kinzoku Kogyo Kabushiki Kaisha). British Patent 849,512. Sept. 28, 1960.

Uranium tetrafluoride in the form of large high-purity water-free crystals may be prepared from aqueous solutions of U^{6+} by electrolytically reducing U^{6+} to U^{4+}, extracting U^{4+} with an organic solution of an organic phosphate, amine, or chelating agent, and adding a soluble fluoride to the organic extract in order to precipitate UF_4, which then is filtered, washed, and dried in a furnace. The solid before drying contains >97% UF_4 and ~0.4% H_2O and consequently can be easily dried to 0.02% H_2O content. The preferred extractant is di-2-ethylhexyl hydrogen phosphate, although isooctylamine and thenoyl trifluoroacetone can be used as an amine and a chelating agent, respectively. Uranium tetrafluoride prepared in this way is particularly suitable for use in the production of uranium metal by the magnesium reduction method. Procedures and a flowsheet are presented for the preparation of UF_4 from crude uranium ore or uranium ore concentrate using the above method; they involve extraction of uranium and stripping the extract with carbonate solutions prior to the electrolytic reduction, extraction, and precipitation of UF_4. Three examples of UF_4 preparation from ore and solutions of uranium are given. (D.L.C.)

Separation Processes

272 CF-58-11-91(Rev.)

Oak Ridge National Lab., Tenn.

RECENT DEVELOPMENTS IN FEED PREPARATION AND SOLVENT EXTRACTION. F. R. Bruce, R. E. Blanco, and J. C. Bresee. Mar. 20, 1959. 67p. OTS.

For presentation at the 5th Nuclear Congress, Cleveland, April 7, 1959.

Increasing emphasis has been placed recently on the application of solvent extraction to the recovery of uranium and plutonium from spent power-reactor fuels. Zircaloy-2 jackets were removed from PWR blanket type fuels by dissolution with the Zirflex process, and the UO_2 cores were dissolved in 10 M HNO_3. Zirflex treatment of prototype samples irradiated to 2500 Mwd/ton resulted in satisfactory dissolution rates and losses to the dejacketing solution generally less than 0.2% for uranium and plutonium. Zr-U alloy fuels were dissolved in 6 M NH_4F and adjusted for solvent extraction by the addition of $Al(NO_3)_3$ and HNO_3. In an alternative procedure, fluoride was recycled by metathesis and precipitation. Stainless-steel jackets were removed from Consolidated Edison type fuels by dissolution in 6 M H_2SO_4 (Sulfex process), and the ThO_2-UO_2 core was dissolved in 13 M HNO_3-0.04 M F-0.04 M Al. Dejacketing losses in unirradiated samples were about 0.02%. Use of the ORNL Reference Darex flowsheet for APPR processing resulted in solvent-extraction feed containing 30 ppm chloride. Mechanical equipment was designed to declad SRE fuel, and chop and leach techniques are being developed to treat stainless- and zirconium-clad ceramic fuel. A solvent-extraction flowsheet was developed for Foreign Research Reactor Fuels, (Al-20% enriched U alloy) using a revised tributyl phosphate extraction system for the separation of plutonium from uranium. Feasibility tests were carried out on the coupling of Redox solvent-extraction with Darex and Niflex head-end treatments. New solvents for the reprocessing of power-reactor fuels are being studied. Among these, the amines show an order of magnitude greater radiation stability than does tributyl phosphate. A primary amine was proposed for the recovery of uranium and plutonium from Sulfex decladding wastes. (auth)

273 CF-60-8-2

Oak Ridge National Lab., Tenn.

EUROCHEMIC ASSISTANCE PROGRAM. Progress Report for January through June 1960. E. L. Nicholson and E. M. Shank. July 19, 1960. 6p. OTS.

The status of the Eurochemic organization and the preliminary plant design are summarized. The Eurochemic charter was ratified by all participating countries and the company organized with the General Manager's Office in Brussels and with three departments (administrative, technical, and research) in Mol. Project IV (Report ORNL-CF-60-2-72) remained essentially unchanged except for the stated capacity, which is now 350 kg/day of natural uranium in aluminum or magnesium cladding and 250 kg/day of slightly enriched power reactor fuels clad in Zircaloy-2 or stainless steel. Contract negotiations with St. Gobain of France were completed in April, and architect-engineering work was started in May on a detailed 6-month pre-project study. Construction of the bridge to the plant area and the office building is in progress. Laboratory-scale development work on ion exchange for plutonium purification was concluded and trilaurylamine extraction is being studied as an alternative to ion exchange. Nonradioactive testing of flowsheets with uranium in miniature mixer-settlers is continuing. Since Eurochemic has not signed a new agreement with the USAEC, the future of the program is uncertain. (auth)

274 CNC-41

Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.

COMPORTAMENTO DI ALCUNE AMMINE ALIFATICHE TERZIARIE NELL'ESTRAZIONE DI SOLUZIONI NITRICHE DI URANIO E DI PRODOTTI DI FISSIONE. (Behavior of Some Tertiary Aliphatic Amines in the Extraction of Uranium Aqueous Solutions and Fission Products). M. Ziferero and F. Baroncelli. July 1960. 43p.

The extraction behavior of aqueous solutions containing nitric acid, uranyl nitrate, and fission products was investigated using solutions of long-chain tertiary amines in hydrocarbon diluent. Four different commercial products ranging from tri-octyl to tri-dodecyl amine have been tested. The partition coefficients of nitric acid, uranium, and some of the more important fission products were determined in various experimental conditions. Decontamination factors in scrub and strip operations were gained in bench-scale experiments. (auth)

275 DP-507

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

RADIOCHEMICAL SEPARATIONS PLANT STUDY. PART I. SITE CONSIDERATION. R. J. Christl. Aug. 1960. 9p. Contract AT(07-2)-1. OTS.

Site considerations for a radiochemical separations plant are discussed relative to geology, hydrology, and meteorology of an area. (C.J.G.)

276 HW-62843

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

LOW SPEED SAW TESTING. V. L. Hammond and V. P. Kelly. June 9, 1960. 40p. Contract AT(45-1)-1350. OTS.

The results of low-speed circular saw and hacksaw studies on the removal of hardware from fuel elements (hardware is defined as that part of the fuel element that does not contain core material). Both saws produced successful results, but the hacksaw was selected because of its lower cost. Methods of operation are proposed. (C.J.G.)

277 IDO-14511

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

BARIUM FLUOZIRCONATE PRECIPITATION FROM HYDROFLUORIC ACID–ZIRCONIUM FUEL REPROCESSING SOLUTIONS. PART I. PROCESS CHEMISTRY. B. E. Paige. Sept. 6, 1960. 30p. Contract AT(10-1)-205. OTS.

Studies were made to determine the feasibility of a barium fluozirconate precipitation as a head-end or tail-end treatment for high hydrofluoric acid-zirconium fuel reprocessing. The precipitation conditions, the degree of zirconium removal, and the uranium loss were established. Based on data obtained, flowsheets are presented for head-end precipitations with barium nitrate, alkaline barium compounds, and a barium fluoride-barium nitrate mixture. (auth)

278 IDO-14520

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

IDAHO CHEMICAL PROCESSING PLANT TECHNICAL PROGRESS REPORT [FOR] JANUARY–MARCH 1960. C. M. Slansky and F. M. Warzel—John R. Bower, Jr., ed. July 13, 1960. 61p. Contract AT(10-1)-205. OTS.

The ICPP processing schedule included MTR, ETR, and other aluminum-type fuels that were processed through the TBP headend at 75 to 100% of flowsheet rates and through the Hexone second and third cycle extraction system at up to 150% of flowsheet values, achieving an over-all recovery of 99.60%. In carrying out basic studies on aqueous zirconium processing, results obtained during the potentiometric titration of zirconium-fluoride-nitric acid solutions with sodium hydroxide were explained by a mechanism in which the untitrated zirconium fluoride species is converted to a fluozirconate and further hydrolysis proceeds via a fluozirconate route. A modified Zirflex flowsheet for processing 2.5% U-Zr alloy fuels is proposed as a result of bench scale dissolution studies on unirradiated PWR plates that showed that dissolver solutions could be stabilized by adding aluminum nitrate and nitric acid, that higher ammonium fluoride concentrations increased the dissolution rate, that higher hydrogen peroxide concentrations lowered the dissolution rate and decreased solution stability, and that ammonia removal by boiling with or without air sparging had little effect on the reaction. Density curves for Zirflex solutions are reported. First tests of the pilot plant for continuous dissolution of zirconium-type elements have indicated that the dissolution rate is approximately four times as great as predicted on the basis of batch dissolution rates and comparison with the rate ratio for batch vs. continuous dissolution of aluminum, which was used to establish the dissolver size. The continuous dissolution rate for a 2% zirconium-98% uranium element was approximately proportional to the acid feed rate and reached 190 kg/day at an acid feed rate of 36 l/hr (11M nitric acid, 0.30M hydrofluoric acid, and 0.35M aluminum nitrate). Development of new waste treatment methods is influenced by waste volumes and the associated storage costs involved. A survey of current and proposed zirconium fuel processes indicates highest waste volumes are generated by the Zirflex and the original STR processes, with moderate improvement for the currently modified STR process. In identification of ionic species present in process solutions, electrolytic conductance has been useful as an analytical tool; data obtained are of significance in application to process problems as well as instrumental analysis and control. The Onsager-Fuoss limiting law for electrical conductance of electrolyte mixtures has been tested by measurements of KCl-HCl mixtures at 25°C and, within experimental error, has been confirmed. Experiments on electrolytic dissolution of stainless steel in nitric acid, designed to study the quantity of anode sludge formed as the temperature was varied from 40 to 90°C, the current density from 0.4 to 1.2 amp/cm^2, and the acidity from 1 to 5M, disclosed that minimum sludge (0.2 to 0.5 g/100 g of metal dissolved) was formed at the lower temperature and under high-current density-high acidity or low-current density-low acidity conditions. Other combinations of these variables gave 1 to 3 g of sludge per 100 g of metal dissolved. An extension of the ARCO process which employs molten lead chloride as a solvent for zirconium-uranium alloys followed by regeneration of lead chloride from the lead produced, utilizes direct chlorination in the dissolver vessel to rechlorinate lead as it is formed or to directly chlorinate (by addition of chlorine to the lead chloride bath) and rapidly dissolve a wide variety of metals including stainless steel, chromium, niobium, aluminum, and zirconium at rates of at least 15 to 30 mg/cm^2/min. Relatively rapid attack eliminates many materials from consideration for dissolver construction, but an alumina ceramic appeared to withstand the dissolution medium. In continued studies of solvent stability in the TBP-HNO_3-Zr system, it has been shown that the Zr-TBP reaction is first order with respect to zirconium concentration, the half-time for the reaction increases as the zirconium concentration increases, and the activation energy is 21.0 kcal. At 50°C the half-time of the reaction is about 15 hr. (For preceding period see IDO-14512.) (auth)

279 NYO-2521

Radiation Applications Inc., New York.

FOAM SEPARATION IN NUCLEAR PROCESSING. Annual Report [for] April 1, 1959 to June 15, 1960. Sept. 6, 1960. 41p. Contract AT(30-1)-2384. OTS.

By splitting the foaming-agent feed into two streams, one fed at the top, the other at the bottom of the column, and adding an expanded section, high recovery factors (250 to 300) and decontamination factors (700) were obtained simultaneously. The expanded section feature also increased significantly the foamate volume reduction (200 to 300). Of the foaming agents screened, Deriphat-160 (dodecyl-imino diacetic acid, Na Salt) gave reasonably good fractionation of samarium from strontium when both are present in solution. Enrichment of cesium in the foam was obtained with the system sodium tetraphenyl boron-dodecyl benzyl diethylene triamine tetracetic acid, Na Salt. To reduce the inert-solids content, countercurrent washing of the foam with foaming-agent solution was introduced. By estimating the potential volume reduction through evaporation, over-all VR values were estimated. For samarium separation with Deriphat-160, these over-all VR values were in the range 15 to 20×10^3 for a single column. Accompanying over-all recovery factors of about 5 to 15×10^3 and decontamination factors of 100 to 150 were observed. It was noted that washing the foam not only reduced its solid content, but also allowed better drainage through a decrease in viscosity. (auth)

280 TID-6420

Michigan Chemical Corp., St. Louis, Mich.

SEPARATION OF YTTRIUM AND THE RARE EARTHS BY LIQUID-LIQUID EXTRACTION. Progress Report [for] October 3, 1957 to February 7, 1958. Report 150. James Q. Penrod. Apr. 23, 1958. 14p. Project No. 942. OTS.

Various liquid-liquid extraction systems for the separation of yttrium and the rare earths are described. These laboratory single extractions (shake-outs) were conducted to determine which solvent extraction mechanisms should be considered for trial on a larger scale. The best separation of yttrium and the heavy rare earths from the light rare earths was accomplished with a monododecyl phosphoric acid in solutions of kerosene and n-decanol using scrub solutions of hydroxyethylethylenediaminetriacetic acid with the pH at 4.0 to 5.0. Thus far no other extracting agents investigated have given separation factors comparable to those obtained with the phorphoric acid reagent under the particular conditions used in these experiments. (auth)

281

SEPARATION OF RADIOCOBALT FROM NICKEL. R. Mills and M. J. Vernon (Australian National Univ., Canberra). Anal. Chim. Acta 23, 388-90(1960) Oct. (In English)

A reinvestigation of the classical cobaltinitrite method for the separation of cobalt from nickel has shown that the standing time can be reduced to less than 60 min with >99% recovery. The method is suitable for the separation of some of the short-lived cobalt isotopes. (auth)

282

SYSTEMATIC SEPARATION OF FISSION PRODUCTS BY SOLVENT EXTRACTION METHOD. Toshiyasu Kiba, Shigeru Ohashi, and Toyoo Maeda (Kanazawa Univ., Japan). Bull Chem. Soc. Japan 33, 818-21(1960) June. (In English)

A new scheme for separating fission products, Zr^{95}–Nb^{95}, Ce^{144}, Pm^{147}, Y^{90}, Sr^{90}, Ru^{106}, and Cs^{137}, by the four-step liquid-liquid extractions was presented. First, Zr^{95} and Nb^{95} were extracted from a 5 M hydrochloric acid solution into chloroform with cupferron. Second, rare-earth nuclides, Ce^{144}, Pm^{147}, and Y^{90} were extracted from an acetate buffered solution of pH 4 to 5 into chloroform with cupferron. Third, Sr^{90} was extracted from an acetate buffered solution of pH 8 into hexone (methyl isobutyl ketone) with TTA (2-thenoyl-trifluoroacetone). Fourth, Ru^{106} was extracted from 5 M hydrochloric acid solution with TBP (tri-n-butyl phosphate)-kerosene in the presence of stannous chloride or extracted with TBP in the presence of hydroxylamine. Then Cs^{137} was left in the last aqueous solution. Strippings of nuclides extracted in the organic phases could be attained by shaking each organic phase with nitric acid. (auth)

283

SEPARATION OF ZIRCONIUM AND HAFNIUM. D. Saint-James. Métaux (Corrosion–Inds.) 34, 9p.(1959) June. (In French)

A brief review is given of the chemical separation of zirconium and hafnium. The two methods used for the production of the metal (the Kroll Process and electrolysis of fused salts) and the three methods used in the treatment of ores (alkaline fusion, reduction at high temperatures, and attack with fluoride) are first described. The separation of zirconium and hafnium by crystallization of the fluozirconate, reduction of $ZrCl_4$ into the subchloride, and solvent extraction are then discussed. Production of the metal by igneous electrolysis is described, and the electrolytic cell used is sketched. (J.S.R.)

284

EFFECTS OF SALTING AGENTS ON URANYL NITRATE DISTRIBUTION BETWEEN AQUEOUS SOLUTION AND DI-ISOAMYL ESTER OF METHYLPHOSPHONIC ACID. A. S. Solovkin. Zhur. Neorg. Khim. 5, 2119-31(1960) Sept. (In Russian)

The influence of salting agent on uranyl nitrate extraction with di-isoamyl ester of methyl-phosphonic acid (DAMPA) was studied. It was found that without nitric acid, $\lg \alpha = f[\lg(DAMPA)_0]$ is a straight-line function inclined at ~2 all the way up to the highest concentrations of extraction agent in the organic phase. The relation between ρ' and δ_s was determined (ρ' is the surface density of water molecules in the first coordinate ion layer and δ_s is the coefficient of total ion force of the solution and the individual salting agent), and a method is suggested for evaluating ρ' and δ_s on the basis of distribution data. The ratio between them was found to be $\delta_s = 0.212 - 3.45\ \rho'$. The thermodynamic interpretation is included. All experiments were carried out at room temperature (~22°C). (R.V.J.)

285

IMPROVED ANION-EXCHANGE PROCESS FOR URANIUM RECOVERY. David Anthony Everest, Ronald Alfred Wells, and Gordon Henry Elliott Sims (to United Kingdom Atomic Energy Authority). British Patent 848,764. Sept. 21, 1960.

An anion-exchange material suitable for uranium recovery may be prepared by aminating polyvinyl chloride sheets with NH_3 or an amine to the extent that at least 1% of the combined chlorine atoms is replaced with basic nitrogen-containing groups. If a polyamine, e.g., a diamine, is used for the amination, some crosslinking is introduced into the sheets with a resultant increase in mechanical strength. This material in sheet form is valuable where the aqueous solution of uranium is a pulpy one, e.g., those from leaching ores; the solid particles are kept in suspension by an upward gas flow. Two examples are given of this method; in both cases, treated 0.05-in. and 0.006-in. sheets in contact with a solution of 1 g/l U_3O_8 had a U_3O_8 uptake on the order of 1.2 mg/cm^2. (D.L.C.)

286

PLUTONIUM COMPOUNDS. (to United Kingdom Atomic Energy Authority). British Patent 849,651. Sept. 28, 1960.

Stable organic condensation complexes of plutonium, in reduced or oxidized form, may be prepared using β-diketones and are useful in recovering plutonium from irradiated uranium. The complexes are prepared by mixing an acid solution of plutonium with the diketone and sufficient alkali to make the solution alkaline and are generally in the form of a red or red-brown crystalline precipitate. For complexes of Pu^{4+}, it is preferable to first precipitate it as $Pu(OH)_4$, dissolve it in acid, and then treat it in the above manner. In plutonium recovery, plutonium is first reduced and precipitated with a carrier, the plutonium in the precipitate redissolved in acid, and the acid solution treated to precipitate the complex which is then separated or extracted with an organic solvent. An extensive list of β-diketones that can be used is given; other diketones with their carbonyl groups separated by a relatively small number of carbon atoms may be used. Two examples of the preparation of such complexes are given using benzoylacetone and acetylacetone. (D.L.C.)

287

PROCESSING OF NITRATE SOLUTIONS CONTAINING THORIUM AND URANIUM^{233}. (to Atomic Energy of Canada Ltd.). British Patent 850,887. Oct. 12, 1960.

A method is given for the solvent extraction of thorium and uranium from HNO_3 solutions of neutron-irradiated fuel rods, whereby the solution is treated with a solution of 10 to 60% (preferably 30 to 50%) tributyl phosphate in decahydronaphthalene (decalin) in the first column of a three-column system. The organic extract is then scrubbed with a solution of $Al(NO_3)_3$ and HNO_3 to wash out the extracted fission products and passed to the second column where it is scrubbed with a HNO_3 solution to remove thorium. In the third column, the organic extract is washed with water or water acidified with HNO_3 to remove U^{233}. Since decalin sometimes contains impurities that react with HNO_3, it should be purified with concentrated H_2SO_4 and two water washes. A flowsheet of the three-column system is presented. (D.L.C.)

288

SEPARATION OF PLUTONIUM. (to United Kingdom Atomic Energy Authority). British Patent 851,171. Oct. 12, 1960.

Methods are given for separating plutonium, fission products, and uranium in irradiated uranium by absorption on Nb_2O_5. The acid solution of the substance to be separated is passed through a porous bed or column of granular (60 to 100 mesh) hydrated Nb_2O_5, in which plutonium and fission products are absorbed together with a small amount of uranium. The absorbed uranium can be removed from the bed by elution with 0.25M H_2SO_4, and then the plutonium and fission products can be eluted with a strong acid solution, e.g., 3N HNO_3 or a solution 0.5M or more in H_2SO_4 and 1M in Na_2SO_4. Plutonium can be separated from fission products by first oxidizing it to the hexavalent state in solution and then passing the solution through a Nb_2O_5 bed, in which case plutonium is less strongly absorbed than fission products. For example, a H_2SO_4 solution containing fission products and 5×10^{-6} g plutonium per 100 g solution and treated in the above manner retained 43% of its oxidized plutonium and negligible amounts of its fission products. Granular Nb_2O_5 suitable for use as adsorbents may be prepared by precipitation from aqueous solution, drying at 100°C, and crushing to the required size. Batch adsorption experiments were performed on various solutions of plutonium and fission products (with and without uranium), and the percentages adsorbed are given, the fission product concentrations being expressed as β and γ activities. Desorption experiments were also performed using HNO_3 and H_2SO_4-Na_2SO_4 eluants. (D.L.C.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

289 AGARD-245

North Atlantic Treaty Organization, Paris. Advisory Group for Aeronautical Research and Development.

ON MODELS FOR THE PROBABILITY OF FATIGUE FAILURE OF A STRUCTURE. Emanuel Parzen. Apr. 1959. 26p.

Presented at the Ninth Meeting of the Structures and Materials Panel, held Apr. 20-25, 1959, in Paris, France.

The statistical nature of the fatigue life of materials is discussed. Possible probability laws for determining the number of load cycles to failure are presented. The construction of S-N curves and models for probability laws is demonstrated. A probabilistic model for the life of a structure before fatigue failure is presented. (C.J.G.)

290 DEG-Inf-Ser-80

United Kingdom Atomic Energy Authority. Development and Engineering Group, Capenhurst, Ches., England.

BIBLIOGRAPHY ON AXIAL FLOW COMPRESSORS, INCLUDING BLADES, CASCADES AND OTHER RELATED MATERIAL (1934-1958): PART I. R. Bramley and E. McCoy. Dec. 9, 1959. 108p. BIS.

An extensive bibliography on the design, construction, operation, performance, and application of axial-flow compressors is presented. References are contained on the design, testing, performance, and operational theory of turbine blades, cascades, single-stage compressors and fans, and turbines. (C.J.G.)

291 DP-487

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

LEAKAGE OF WATER FROM GASKETED JOINTS PROPOSED FOR THE HWCTR. PART I. Frederick C. Apple. July 1960. 12p. Contract AT(07-2)-1. OTS.

When mockups of typical gasketed joints proposed for the HWCTR were subjected to thermal and pressure cycling that simulated reactor operating conditions, the average leakage rate was less than 0.11 lb of water per year per linear inch of gasket. The joints were exposed to deionized light water and were cycled 100 times from about 70°C and atmospheric pressure to 250°C and 1000 psig. (auth)

292 NAA-SR-5387

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

FAST RESPONSE, LOW INERTIA VACUUM FURNACE. L. H. Rachal. Oct. 1, 1960. 10p. Contract AT-11-1-GEN-8. OTS.

A fast-response precision-controlled low-thermal-inertia vacuum furnace is described. (auth)

293 NASA-TN-D-295

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

HALOGEN-CONTAINING GASES AS LUBRICANTS FOR CRYSTALLIZED-GLASS-CERAMIC-METAL COMBINATIONS AT TEMPERATURES TO 1500°F. Donald H. Buckley and Robert L. Johnson. Oct. 1960. 20p.

The gases CF_2Cl-CF_2Cl and CF_2Br-CF_2Br were used to provide lubrication for Pyroceram 9608 sliding on various nickel- and cobalt-base alloys. The use of Pyroceram 9608 minimized the corrosive wear encountered with metal-metal combinations using halogen-containing gases reported in earlier research. In the friction and wear experiments a hemispherically tipped rider (Pyroceram 9608) under a 1200-gram load slid on a disk (nickel- or cobalt-base alloy) rotating at 3200 ft/min. The gas CF_2Br-CF_2Br was an effective lubricating agent for Pyroceram 9608 sliding on Hastelloy R-235 and Inconel X at temperatures up to 1400°F. The gas CF_2Cl-CF_2Cl was effective in providing lubrication for Pyroceram 9608 on various cobalt-base alloys at 1000°F. (auth)

294 ORNL-2988(p.436-42)

Oak Ridge National Lab., Tenn.

POSTIRRADIATION EXAMINATION LABORATORY. A. R. Olsen and R. E. McDonald.

Final design work on the High Radiation Level Examination Laboratory was completed by the architect-engineer, and a contract was awarded for construction of the new hot-cell facility during the next 14-month period. Much of the specialized equipment required to perform various in-cell metallurgical operations has progressed to an ad-

vanced stage of development. Despite the limitations of the present facilities for handling highly radioactive materials, continued support was given to the in-reactor corrosion effort of the Aqueous Thermal Breeder Program. In addition, a failure analysis of a gamma-heating probe was performed and support was given to the ORR Core Corrosion and the Beryllium Evaluation Program. Exploratory work in the field of remote replication for examination of surface topography of irradiated samples is encouraging. The technical feasibility of preparing reliable replicas with a minimum of effort and low exposure to operating personnel has been demonstrated.(auth)

295 SCR-230

Sandia Corp., Albuquerque, N. Mex.

STATUS OF SANDIA LABORATORY HYPERSONIC FACILITIES. R. C. Maydew. Aug. 1960. 13p. OTS.

Presented at 13th Supersonic Tunnel Association Meeting, Chance Vought Aircraft, Dallas, Apr. 26-28, 1960.

The installation of the pilot hypersonic tunnel was completed in December 1959. Considerable trouble was encountered in the shakedown of the burner system and operation of the pebble-bed heater at elevated temperatures. The heater now functions properly. The bed temperature is automatically maintained at a constant temperature of approximately 2000°F. The calibration checkout of the pressure control system was completed in February 1960. The system controls stagnation pressure to within ±0.5 percent. Calibration of the M = 9 contoured nozzle is underway. Diffuser, boundary layer growth, and water-cooled balance studies are planned. The design of the 18-in. facility is approximately 70% complete. Fabrication contracts for the upstream valving, pressure control system, heater, 16-in. slide valve, and revolver have been let. Component installation will commence in August 1960; a tentative operational date of February 1961 is planned. (auth)

296 WAPD-BT-19(p.1-8)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

A SHELL THEORY SOLUTION FOR DISPLACEMENTS AND STRESSES IN OMEGA SEALS. D. S. Griffin.

Equations were derived for determining displacements and stresses in a flexible pressure seal (the ω seal). Treating the seal as a thin-walled circular cylinder, classical shell theory is applied to obtain solutions for the conditions of loading and certain end conditions. The stress solution obtained for defections in the plane of the cross section of the seal was in agreement with that obtained by thin, curved bar theory if the Poisson effect is taken into account. For an axial deflection, two forms of solution were obtained, for free or restrained ends of the seal. (C.T.G.)

297 WAPD-BT-19(p.9-24)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

OMEGA SEAL WELD: ELASTIC PRESSURE AND DEFLECTION EFFECTS. J. A. Keane.

A stress analysis is presented of an infinitely long ω seal weld subjected to internal pressure and relative deflections between the two structural members joined by the weld. A method for estimating the shear effect and shear distribution is given. The effect of fixity on the magnitude and position of the maximum bending stress was studied. The effects of end fixity on the stresses developed when the partial cylinder is subjected to a vertical deflection were analyzed. (C.J.G.)

298 WAPD-BT-19(p.25-30)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

PLASTIC DEFLECTIONS IN AN OMEGA SEAL WELD. J. A. Keane.

An elastic-plastic analysis of an infinitely long, right-circular cylinder fixed at two points near the nadir and subjected to internal pressure and a relative vertical deflection between the two fixed points is presented. Based on the analysis, plastic deflections are approximated in an ω seal weld. (C.J.G.)

299 WAPD-BT-19(p.71-4)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

HYDROGEN ADDITION TEST ON A MAIN COOLANT PUMP. R. J. O'Brien.

Tests were performed to determine the effects of hydrogen injection into the suction line of a main coolant pump both with the pump operating and with the pump stopped. It was concluded that such injection does not constitute a serious hazard to a main coolant pump. (auth)

300 WAPD-T-1177

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

FUNDAMENTALS OF RADIOGRAPHY. R. C. Barry. 1960. 23p. Contract AT-11-1-GEN-14. OTS.

An attempt is made to describe briefly the radiographic processes; to review the nature of penetration of radiation, sources of radiation, radiation protection, exposure and processing techniques; and to provide a short discussion of film interpretation and standards. (W.L.H.)

301 WAPD-TM-227

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

STEAM JET PUMP ANALYSIS AND EXPERIMENTS. Ronald P. Rose. June 1960. 129p. Contract AT-11-1-GEN-14. OTS.

An analytical and experimental study of steam jet pump operating characteristics is described. Nozzle-throat pressures are related to inlet-water temperature and operating pressure by an empirical expression for the case of a steam jet pump with a uniform-diameter mixing tube. Test results are presented for operating pressures of 150 and 225 psia with nominally equal pressures for the steam and water flow entering the pump. Predicted and observed pump heads and flow rates are in relatively good agreement. The analysis uses a one-dimensional model in which the steam and water flows are mixed by the abrupt collapse of the water annulus into a core of steam. Pressure measurements along the wall of the mixing tube reveal that the mixing process is accompanied by a sudden rise in static pressure similar to that encountered in normal shocks. Transverse probe measurements of static and stagnation pressures in the mixing tube are discussed. (auth)

302 JPRS-2737

RADIOISOTOPE LABORATORY OF TIMIRYAZEV ACADEMY. V. V. Rachinskii (Rachinskiy) and F. P. Platonov. Translated from Izvest. Timiryazev. Sel'skokhoz. Akad. No. 6, 239-50(1959). 21p. OTS.

The design and equipment of a laboratory for the study of radioactive substances are described. (J.R.D.)

303

LIQUID NITROGEN LEVEL FILLER CONTROL. V. E. Schupbach (Goodyear Atomic Corp., Portsmouth, Ohio). Anal. Chem. 32, 1536(1960) Oct.

A device is described which was developed to control the filling of mass spectrometer cold-trap Dewar vessels automatically from liquid nitrogen storage Dewars, independent of any other system. A sketch of the device is shown. Its main component is an inverted Hoke HGP valve

that is very simple and remarkably efficient. The operation of the controller depends on the temperature and, consequently, the pressure of a 2-g propane charge in the sensing element. When the liquid nitrogen level falls too low, the vapor pressure of the propane charge increases due to the warming of the sensing element, thus closing the vent valve to the liquid nitrogen storage Dewar; this causes the vapor pressure in the storage Dewar to increase, thus filling the cold-trap Dewar with liquid nitrogen. A potential use would be a process that requires reactions to be carried out in media such as liquid ammonia. With this device the liquid level could be maintained at any required level. (B.O.G.)

304

REMOTELY OPERATED MANIPULATORS MANUFACTURED FOR HANDLING RADIOISOTOPES. József Hirling and Ede Fenyvesi (Csepel Steel and Metal Works, Budapest). Energia és Atomtech. 13, 379-81(1960) Aug. (In Hungarian)

A newly designed and constructed unit makes it possible to handle radioactive materials behind a barrier, although it cannot be used for operations within a closed cell. The movements applied to the handle are transferred to the operating units on the hot side by steel cables. The unit is built on a carriage that can be displaced or fixed in the desired position on its rail. Eight different types of motions can be performed. The unit weighs 3.35 kg. Design details are given. (TTT)

305

THE ELASTOPLASTIC THICK-WALLED SPHERE SUBJECTED TO A RADIAL TEMPERATURE GRADIENT. G. R. Cowper (National Research Council of Canada, Ottawa). J. Appl. Mechanics 27, 496-500(1960) Sept.

An exact solution is obtained for the behavior of an ideal elastoplastic hollow sphere that is thermally stressed by a slowly increasing temperature difference between the inner and outer surfaces. An approximate analysis in which elastic strains are neglected is also presented. It is shown that the approximate analysis gives the asymptotic form of the exact solution at infinitely high temperatures. (auth)

306

MODELING OF LARGE TRANSIENT ELASTIC AND PLASTIC DEFORMATIONS OF STRUCTURES SUBJECTED TO BLAST LOADING. W. E. Baker (Ballistic Research Labs., Aberdeen Proving Ground, Md.). J. Appl. Mechanics 27, 521-7(1960) Sept.

A model law is developed for scaling of response-to-blast loading of structures that undergo large elastic and plastic deformations. The geometrical scaling of response predicted by this law is verified by a series of experiments on small cantilever beams. (auth)

307

A METHOD FOR INVESTIGATING CERTAIN EIGENVALUE PROBLEMS OF THE BUCKLING AND VIBRATION OF PLATES. H. D. Conway (Cornell Univ., Ithaca, N. Y.). J. Appl. Mechanics 27, 557-8(1960) Sept.

A method given for the approximate solution of certain boundary-value problems is used to investigate the eigenvalue problems of the buckling under two-dimensional hydrostatic loading and the vibration of thin plates. The two-dimensional hydrostatic buckling loads of clamped square and equilateral-triangular plates are found by this method, the values agreeing well with the results obtainable by other methods where these results are known. (auth)

308

IMPROVEMENTS IN STEAM GENERATING PLANT AND AN IMPROVED METHOD OF GENERATING STEAM. Ronald Ernest Zoller (to Babcock and Wilcox Ltd.). British Patent 846,996. Sept. 7, 1960.

A steam generating plant, designed for heat transfer from a liquid metal (potassium, sodium, or their alloy) with reduced danger of explosion, is based on the fact that, if steam (especially superheated) rather than water contacts the liquid metal, the risk of explosion is much reduced. In this plant steam is superheated by heat transfer from liquid metal, the steam being generated by heat transfer between the superheated steam and water. Diagrams are given for the plant, which comprises a series of heat exchangers in which steam is superheated; part of the superheated steam is recycled to convert water into steam. Apart from the danger of a steam–liquid metal contact, the main danger is that the superheated steam might cool, coming to the saturated condition; this danger can be averted by setting up means for detecting low steam temperatures. (D.L.C.)

309

IMPROVEMENTS IN AND RELATING TO HEAT EXCHANGERS. Hugo Heinrich Ludolf Ritz (to C. A. Parsons and Co. Ltd.). British Patent 847,218. Sept. 7, 1960.

A heat exchanger is designed comprising a nest of tubes with one fluid flowing through the tubes and another fluid flowing in the opposite direction over the outer tube surfaces. The tubes have attached helical fins and longitudinal baffles, the baffles serving as interlocking members that form a series of enclosed channels for passage of the second fluid. (D.L.C.)

310

IMPROVEMENTS IN OR RELATING TO JOINTS, FOR EXAMPLE, FOR PIPES. Harry Chilton (to United Kingdom Atomic Energy Authority). British Patent 849,123. Sept. 21, 1960.

Flanged pipe joints of three kinds are described in which no loosening or leakage can take place owing to thermal expansion, even if different materials, e.g., steel and graphite, are used for the two pipes being connected and the bolts used to clamp the flanges together. The first joint is comprised of two flanged pipes so constructed that the plane where the bolt head contacts its flange coincides with the sealing plane. In the second joint, the seal is maintained by rings surrounding the bolts that exert pressure on the sealing plane should differential expansion occur; the rings, bolts, and one pipe is steel, whereas the other pipe can be graphite. The third joint is comprised of pipes having sectional 60° flanges and 60° gaps so that the flanges interleave. Assuming a uniform temperature throughout the joints, radial, but not axial, movement of the pipe end faces is allowed. (D.L.C.)

311

IMPROVEMENTS IN OR RELATING TO VACUUM TAPS. Raymond Skutt Barton (to United Kingdom Atomic Energy Authority). British Patent 849,253. Sept. 21, 1960.

A vacuum tap employing a soft low-vapor pressure metal, e.g., indium, to make the seal is invented and is comprised of a seating and a closure member, the seating being an annular trough containing the metal and the closure having a sharp-edged skirt. In operation, a seal is effected by pressing the skirt into the metal. Since the seal tends to deteriorate after making and breaking it a few times, an electric heating element is wound around the outside of the trough to re-form the metal surface by melting. (D.L.C.)

312

IMPROVEMENTS IN OR RELATING TO VACUUM MELTING FURNACES. Harrison John Hall-Wilton, Raymond Williams, and James Rostron Wright (to United Kingdom Atomic Energy Authority). British Patent 849,563. Sept. 28, 1960.

A vacuum-melting furnace is designed so that vacuum can be maintained during recharging. It comprises an evacuable container, an access chamber, and a vacuum-melting chamber connected by openings and having means for transferring a crucible between the access chamber and the melting chamber via the openings. (D.L.C.)

313

A METHOD OF ESTABLISHING A FLUID-TIGHT CLOSURE. (to Atomic Energy of Canada, Ltd.). British Patent 849,581. Sept. 28, 1960.

A closure assembly for sealing off tubular members is described which is comprised of an annular seating surface for the member, a flexible sealing disk, a threaded plug for engagement with the member, and a push rod located in a central hole in the plug for deflecting inward the center of the disk seated in the member. Sealing is effected by moving the projections on the plug into contact with the deflected disk by screwing the plug inward; the push rod is then withdrawn, and fluid pressure applied in the member, resulting in a sealing pressure that is proportional to the fluid pressure. (D.L.C.)

314

IMPROVEMENTS IN OR RELATING TO CONTAINERS FOR THE ISOLATION OF RADIOACTIVE MATTER. Stanley Wolstenholme, Werner Treuherz, and Hubert Percival Schofield (to Everglades Ltd.). British Patent 849,655. Sept. 28, 1960.

A resilient container for storage or transport of radioactive matter or radioisotopes may be made from a homogeneous mixture of lead powder and rubber or synthetic resin, the preferred lead content of the mixture being between 80 and 88%. The advantage of this container over conventional lead containers is that protection from mechanical shock is increased, especially when its interior is corrugated to provide a firm yet floating support for glass capsules, etc. Two alternative forms of this container are shown; one is a simple one, while the other is a nest of tightly fitting concentric containers. Means are described for holding the detachable lid in position. Several examples are given of the preparation and molding of lead-rubber–synthetic resin mixtures. (D.L.C.)

Heat Transfer and Fluid Flow

315 AD-235083

Princeton Univ., N. J.

HEAT TRANSFER IN OSCILLATING FLOW. Progress Report for the Period July 1, 1958 to October 1, 1959. Aeronautical Engineering Report No. 483. David T. Harrje and E. Croke. Oct. 3, 1959. 60p. Contract USN-ONR-NONR-1858(29).

An investigation of heat transfer in oscillating gas flow is reported. A series of tests was conducted in which h-f longitudinal pressure and velocity oscillations were imposed on a steady flow of cold air through a duct for conditions of fully established pipe flow. Heat was transferred from an electrically heated ribbon of Nichrome, which was set in the duct walls, to the gas. Tests were made under conditions in which the duct was resonant over a wide frequency range; observation of the results showed that heat transfer increases as much as 70%. These results indicate that the induced pressure waves were allowed sufficient time in the duct to steepen into weak shocks before reaching the heat-transfer section. A discussion of important heat-transfer parameters is included along with diagrams that are designed to describe various transfer phenomena. (J.R.D.)

316 GEAP-3319

General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

SUPERHEAT PROCESS TUBE HEAT TRANSFER TESTS, NUCLEAR SUPERHEAT PROJECT. E. Janssen. Jan. 5, 1960. 29p. Contract AT(04-3)-189. OTS.

Tests were conducted to determine the outside clad temperature of the SADE process tube, under conditions of zero flow. The fuel element was simulated by a cartridge type electric heater and the superheated steam by nitrogen and helium. Heat transfer by natural convection inside the process tube was negligible; heat transfer through the gas is by conduction and radiation. The coefficient of emissivity ϵ (304 stainless-steel tube and liner, and 321 stainless steel) was found to be 0.495. (See also GEAP-3290.) (C.J.G.)

317 HW-65240

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

AN EQUATION FOR UNSATURATED FLOW BASED UPON THE DARCY EQUATION AND AN ANALOGY OF THE POISEUILLE EQUATION. Paul Preston Rowe. May 15, 1960. 85p. Contract AT(45-1)-1350. OTS.

An equation for unsaturated flow was obtained by using an analogy between the Darcy and the Poiseuille equations. However, the unsaturated flow equation obtained could not be written to contain moisture content explicitly, but instead contained the factor $(\rho')^c$ where ρ' is the fractional effective moisture content and c is a parameter which is nearly a constant for a given soil. The moisture-dependent factor was also written as $(M-\mu'/M_s-\mu_s')^c$ where M is the moisture content, μ' is the moisture content that is not effective in transmitting water, and the subscript, s, refers to saturated conditions. Flow rates at various moisture contents and hydraulic gradients were recorded for seven different soil materials and one sample of white Turkish toweling. The soil materials used varied in particle size distribution from a clay soil (over 60% clay) and particles up to 2.0 mm to Ottawa sand with a particle size range from 0.5 to 1.0 mm. From the flow-rate data, values of the ineffective moisture content μ' at various moisture contents were obtained. Graphs of μ' versus M were drawn for all seven soil materials and for the Turkish toweling. The study of such graphs gave much information about the nature of flow through the various materials. This was particularly true for flow through the Turkish toweling. Use of a dye solution during unsaturated flow through the Turkish toweling resulted in a qualitative confirmation of the validity of the Turkish toweling $\mu' - M$ curves and of the ineffective-moisture concept. The ineffective moisture content was considered to be a measure of the tortuosity of the flow paths. The tortuosity of a soil-water system was found to vary in a rather complex manner with the moisture content. This was demonstrated by the shapes of the $\mu' - M$ curves. These curves showed that the tortuosity can increase, remain constant, or even decrease with an increase in moisture content, depending on certain characteristics of the media. Most of the work was for one-dimensional flow. However, data were collected from a two-dimensional flow experiment. The unsaturated-flow equation developed here was used to predict flow rates from the bottom of the

two-dimensional model. The error between the calculated and measured flow rates ranged from 0.4 to 4.6%. (auth)

318 LA-2449
Los Alamos Scientific Lab., N. Mex.
THE FLOW OF FLUIDS THROUGH CHANNELS WITH POROUS WALLS. Francisco A. Guevara and William E. Wageman. July 1960. 23p. Contract W-7405-eng-36. OTS.

Approximate solutions of the equations of motion governing laminar incompressible fluid flow through cylindrical channels with porous walls are derived. The invalidity of an approximation in the solution of these equations under certain circumstances is pointed out, and the results of a numerical integration in the region where the approximation is invalid are indicated. A description is given of an experiment to verify the calculations, and some interesting results are noted. (auth)

319 TID-6035
Columbia Univ., New York. Engineering Research Labs.
BASIC STUDIES IN HEAT TRANSFER AND FLUID FLOW. Quarterly Progress Report for period April 1, 1960 to June 30, 1960. T. Diskind, D. Lee, R. Lummis, R. P. Stein, and J. H. Vohr. 88p. Contract AT(30-3)-187. (IX-QPR-2-60). OTS.

A summary of research activities in nucleate boiling heat transfer, transient vaporization, film boiling, forced convection boiling, convection heat transfer in noncircular ducts, and transient heat transfer in reactor coolant channels is presented. Research proposals for study of the transient vaporization of liquid at a solid surface and for investigation of flow patterns in forced-circulation boiling flow are included as appendixes. (J.R.D.)

320
CALCULATIONS ON HEAT EXCHANGERS. III. THE 1-M EXCHANGER. E. Slavíček (Inst. of Chemical Tech., Prague). Collection Czechoslov. Chem. Communs. 25, 2071-88(1960) Aug. (In English)

The method of calculation is set forth for the temperature distributions in a 1 – m exchanger (m >3), which has, in general, differing surfaces and heat-transfer coefficients in the various passes. A detailed computation is presented in an example. Explicit formulas are derived for the special case where the product of the exchanger surface and the heat-transfer coefficient is the same in all passes. Cases involving extremal values of the variables are discussed, in particular the case $m \to \infty$. (auth)

321
THERMAL TRANSFER IN TURBULENT GAS STREAMS. EFFECT OF TURBULENCE ON LOCAL TRANSPORT FROM SPHERES. W. W. Short (Convair, San Diego, Calif.), R. A. S. Brown, and B. H. Sage. J. Appl. Mechanics 27, 393-402(1960) Sept.

A series of measurements was made of the local thermal transport in the forward hemisphere and a part of the after hemisphere of a silver sphere 0.5-in. diam. The measurements were made in an undisturbed air stream and at several positions in the wake of a grid inserted in the air stream. The apparent level of longitudinal turbulence was varied between 0.013 and 0.15 for Reynolds numbers up to 3600. At an apparent level of turbulence of 0.013 and a Reynolds number of 3600, the local thermal transfer varied by a factor of eight around the sphere. Increasing the apparent level of turbulence to 0.15 increased the over-all thermal transfer 20 per cent. The local thermal transfer varied by a factor of five at the latter level of turbulence. (auth)

Instrumentation

322 AD-235728
RCA Victor Co., Ltd. Research Labs., Montreal.
SILICON JUNCTION RADIATION DETECTOR. Quarterly Report No. 1 covering Period June 19, 1959 to September 15, 1959. P. P. Webb and R. W. Jackson. 17p. For Canada. Defence Research Board. ECRDC Project T55. Contract PE.69-900102.

In the first 3 months of this project the construction of experimental alpha-particle detector units of various geometries was begun, techniques of fabrication to form large-area junctions with low leakage were worked out, and the effects of some of the fabrication parameters on the detecting properties of the units were investigated. The first units, made of silicon grown in the RCA Victor laboratory, were found to give a poor energy resolution and a pulse with a sharp spike on the leading edge which rendered the pulses unsuitable for use with the usual types of pulse-height analyzer. Other units made from high-grade long-lifetime silicon gave better results but still suffered from the complex pulse shape, particularly at low voltage biases. The pulse shapes were found to be a function of the device geometry, and improved geometries are being worked out to eliminate this effect and to obtain a better energy resolution. The effects of carrier lifetime and resistivity of the base material are also being studied. (auth)

323 AD-235729
RCA Victor Co., Ltd. Research Labs., Montreal.
SILICON JUNCTION RADIATION DETECTOR. Quarterly Report No. 2 Covering Period from September 15, 1959 to December 15, 1959. P. P. Webb and R. W. Jackson. 34p. ECRDC Project No. T55. Contract DRB-900102.

Project work was directed along two main lines. The first was to construct simple "mesa" type α-particle detectors of various sizes using material of high resistivity. The object was to determine a geometry that would make satisfactory detectors and to eliminate the "spike" effects observed on earlier units. After the ways in which detectors could be made were established and some of the construction details were solved, the second problem was to devise a suitable encapsulation that would provide protection for the detector and at the same time allow use of the geometric form required for high resolution. Two capsules were used; the second was the most satisfactory. In this capsule, the device was mounted in the bottom of a standard 2N270 transistor can with the detecting surface facing out through a hole in the bottom of the can. About 10 encapsulated units were made and measured, showing resolutions of better than 3%. Some progress was made in boron diffusion to reduce the resistance of the back contact. An experimental matrix unit was made as a feasibility test of one method of fabrication. Studies were begun on the sources of noise in the α-detector junctions which ultimately set limits on the sensitivity, resolution, and useful lifetime of the devices. (auth)

324 AECU-4498
Princeton Univ., N. J. Project Matterhorn.
ENGINEERING DESIGN OF MICROWAVE ELECTRON DENSITY MEASURING SYSTEMS. Technical Memorandum No. 78. Mark A. Heald. July 6, 1959. 22p. Contract AT(30-1)-1238. OTS.

A number of considerations which enter the design of electron-density-measuring systems is listed and discussed. The Gardner-Wharton swept-frequency dispersive-bridge type interferometer, which yields the "zebra-

stripe" intensity-modulated raster scope display, is considered. (W.D.M.)

325 AERE-NP/R-2404
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
TIME OF FLIGHT MEASUREMENTS, USING A LIQUID SCINTILLATOR PROTON RECOIL DETECTOR, OF THE SPECTRA OF "BOIL OFF" NEUTRONS FROM NATURAL URANIUM. P. E. Cavanagh, C. F. Coleman, D. I. Page, and C. A. Uttley. Nov. 1957. 26p.

A fast-neutron time-of-flight spectrometer system is described which has a resolution of about 10 mμsec. The detector uses an organic scintillator viewed by two multipliers in coincidence, giving an efficiency of about 15% for 50 kev neutrons, with a total noise rate of about 100 cps. The spectrum of "boil-off" neutrons produced by bombardment of natural uranium with 14 Mev neutrons was measured. (auth)

326 BM-RI-5663
Bureau of Mines.
DUAL-INLET SYSTEM FOR A MASS SPECTROMETER. G. L. Cook, R. A. Meyer, and D. G. Earnshaw. May 1960. 11p.

The design of a dual-inlet system for a mass spectrometer is described. The system permits both high-mass and low-mass samples to be analyzed by using a single instrument. (J.R.D.)

327 CF-60-9-107
Oak Ridge National Lab., Tenn.
USE OF THE DD2 AMPLIFIER WITH THE RIDL 200- AND 400-CHANNEL ANALYZERS. H. A. Todd and R. D. Smiddie. Sept. 23, 1960. 5p. Contract [W-7405-eng-26]. OTS.

Modifications to the DD2 amplifier for use with the analog-to-digital converter units of RIDL 200- and 400-channel analyzers are described. (C.J.G.)

328 GA-1585
General Atomic Div., General Dynamics Corp., San Diego, Calif.
A DYNAMIC DIGITAL DELAY GENERATOR FOR USE IN NEUTRON CHOPPER EXPERIMENTS. W. M. Lopez, J. R. Beyster, R. E. Nather, R. B. Walton, and J. L. Wood. Sept. 15, 1960. 11p. Project No. 48.01. Contract AT(04-3)-167. OTS.

The substance of this paper was given in a talk at the American Nuclear Society Meeting in Chicago, June 15, 1960.

From the experimental point of view, the simplest way to integrate a spectrum over the entire die-away history is to vary the phase relationship between the chopper window and the neutron burst from the accelerator in such a way that the chopper scans with equal probability all portions of the neutron die-away history in the assembly. The logical way to accomplish this variation in phase is to use the chopper window as a reference point in time and then to generate a variable time delay, based on the chopper angle, to trigger the accelerator. A transistorized instrument (the wobulator), designed to generate this variable delay, is described. (W.D.M.)

329 HASL-59
New York Operations Office. Health and Safety Lab., AEC.
A TRANSISTORIZED PULSE HEIGHT ANALYZER FOR GAMMA SPECTROSCOPY. Robert T. Graveson. Mar. 23, 1959. 24p. OTS.

Transistor circuits for pulse amplification, pulse amplitude discrimination, and pulse shaping by a 1-μsec monostable trigger circuit are described. A discriminator amplifier system is used to improve the stability of gate settings. The differential between gates may be set over a 1 volt range at any base level. The unit accepts pulses whose amplitudes lie between 0.1 and 10 volts and whose rise time is between 0.1 and 0.3 μsec. It operates to a maximum rate of approximately 100,000 pulses per second. (auth)

330 HASL-60
New York Operations Office. Health and Safety Lab., AEC.
LOW BACKGROUND NUCLEAR COUNTING EQUIPMENT. H. D. LeVine, L. Charlton, and R. T. Graveson. Mar. 23, 1959. 30p. OTS.

Both direct and coincidence counting apparatuses are described. The elimination of cosmic-ray events by coincidence plus gamma-ray shielding permits the reduction of counting rates far beyond that obtainable with shielding alone. By selection of materials and development of new components and techniques, the residual background count of β-counting equipment can be reduced to a very low value. Geiger counter equipment for routine laboratory measurements having a background of 0.7 cpm is described. Scintillation counters are shown to have a background of 0.2 cpm at 30% efficiency. A portable Geiger counter with a 3.7 cpm background is described. (auth)

331 HASL-94
New York Operations Office. Health and Safety Lab., AEC.
ANALOG AND DIGITAL READOUT ON AN IBM OUTPUT WRITER. R. T. Graveson. Sept. 7, 1960. 15p. OTS.

A control system to provide digital printing and to plot an analog trace on an electric-operated output writer is described. The digital mode of operation translates multi-digit numbers through a set of commands to print each digit serially and presents them to the output writer in a time sequence. The analog mode of operation converts a d-c input voltage to a digital number and by tab and space bar commands translates the carriage horizontally a distance proportional to this number. (auth)

332 HW-63824(p.4-9)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
A LARGE NaI(Tl) CRYSTAL FOR GAMMA-RAY SPECTROMETRIC ANALYSIS. R. W. Perkins.

A large NaI(Tl) well-crystal was used for γ-ray spectrometric analysis of radioisotopes in vegetation, farm produce, and other large samples. The crystal is over 9 in. in diameter, 8 in. thick, and has a 3.25-in.-diameter well, which extends to within about 3 in. of the bottom. The well holds 500-g samples in a 500-ml polyethylene bottle. Detection limits and sensitivity obtained with this crystal are described. (C.H.)

333 OOR-1797.2
Pennsylvania State Univ., University Park.
DEVELOPMENT AND APPLICATION OF INSTRUMENTATION FOR X-RAY AND NEUTRON ANALYSIS. Final Report. Ray Pepinsky. Jan. 30, 1960. 20p. DA Project No. 599-01-004. Contract DA36-061-ORD-601.

Work done on development and application of instrumentation for x-ray and neutron analysis is summarized. A major portion is devoted to the automatic x-ray goniometer. (auth)

334 ORNL-2449(p.226-32)
Oak Ridge National Lab., Tenn.
DOSIMETRY METHODS. F. J. Davis, A. E. Carter, et al.

A G-M tube dosimeter was developed which measures γ-

ray dose rate from 0.1 mr/hr to 150 r/hr. It is energy independent above 150 kev and is very insensitive to both fast and thermal neutrons. Neutron-flux spectra in the threshold-detector units may be determined by counting the fission fragments from thin layers of U^{235}, Np^{237}, and U^{238} with silicon-gold surface barrier diodes. The shielding and scattering effects of a concrete wall, the human body, and the threshold-detector units were determined, using threshold-detection methods. A dosimeter belt containing glass-rod dosimeters and several sulfur, gold, and cadmium-shielded gold samples was developed which serves to indicate the orientation of an individual during exposure. A source field is being prepared at the Nevada Test Site for use in calibration and intercomparison of instrumentation in aircraft for radiation surveys used by several government agencies and contractors. (auth)

335 RFX-30

Aktiebolaget Atomenergi, Stockholm.

SNABBA CHOPPERN VID R1. (The Fast Chopper at R1). E. Johansson, E. Lampa, and N. G. Sjöstrand. May 20, 1959. 53p.

A description is given of the construction, safety and control systems, and energy properties of the chopper establishment. A special section is devoted to the various safety questions for the vicinity of the chopper establishment. The neutron physical properties are also reported with a comparison being made between estimated and experimental data. Finally, a summary of the up-to-date completed applicable measurements is given. (tr-auth)

336 TID-6353

Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.

TIMING AND FIRING OF HIGH EXPLOSIVES. Final Report. Report No. B-2098. S. R. Hamilton. June 1960. 32p. Project COWBOY. OTS.

Timing and firing signals for 13 shots (No. 5 through No. 17) of Project Cowboy during the period extending from Jan. 23 to Mar. 4, 1960, are described. This series of high-explosive charges was detonated underground in the Carey Salt Mines near Winnfield, La. A mobile control-point trailer housed the timing and firing system used on this operation; all signals sent to the users and to the zero sites originated from this point. All shots were fired accurately with respect to WWV time, and a record of the actual firing time was obtained in every instance. (auth)

337 TID-6529

Oak Ridge Gaseous Diffusion Plant, Tenn.

THE LINE RECORDER MASS SPECTROMETER AS AN ANALYTICAL INSTRUMENT. W. O. Gentry. [Sept. 1958]. 42p. Contract W-7405-eng-26. (KD-1560). OTS.

Presented at the Instrument Society of America 13th Annual Instrument-Automation Conference and Exhibit, September 14–19, 1958.

Applications of the line recorder mass spectrometer as an analytical instrument are described. Examples of such applications are analysis of isotope abundance in oxygen and argon and continuous measurement of fluorine concentration in a UF_6 process stream. Descriptions of the line recorder and mass scanner are included. (C.J.G.)

338 TID-6601

New Mexico. Univ., Albuquerque.

HIGH STABILITY LC OSCILLATOR FOR USE WITH A CAPACITIVE PRESSURE SENSING ELEMENT (thesis). Arthur J. Eldridge. 1955. 88p. [For Sandia Corp.]. OTS.

The design and development of equipment for the measurement of barometric air pressure to an accuracy beyond that obtainable with commercially available equipment are reported. It is shown that of the possible ways of producing an accurate reading on a barometric mercury column the use of a capacitive type transducer seemed to offer the simplest and most reliable means. It was then shown that an oscillator whose frequency could be varied by the transducer would be of greatest advantage in producing a digital print-out so that in the hands of an unskilled operator pressures accurate to 0.01 mm of mercury could be obtained. The Gouriet-Clapp oscillator performs satisfactorily for use as a variable oscillator in conjunction with the capacitive pressure-sensing element. It exhibits a short-term stability of one part in three million when the resonator temperature is held to within 0.01°C at an ambient temperature of about 26°C. (W.L.H.)

339 TID-6606

Oak Ridge Gaseous Diffusion Plant, Tenn.

A VERSATILE, HORIZONTAL ELECTRON DIFFRACTION UNIT WITH IMPROVED RESOLVING POWER. J. F. McLaughlin and W. W. Harris. Apr. 1, 1960. Decl. Oct. 5, 1960. 23p. Contract W-7405-eng-26. (KL-692). OTS.

The purpose of the work was to modify an existing commercial electron-diffraction unit so as to afford high-resolution diffraction with specimens too large or otherwise unsuited for use in diffraction instruments available. A description of the instrument in its present form and a presentation and interpretation of the results obtained from a number of experiments that have been performed with the instrument are presented. Recommendations for applications of this instrument and an outline of planned additions and improvements which should further extend the versatility and usefulness of the instrument are given. A comparison of electron diffraction and x-ray diffraction is presented. Examples of the various types of patterns that may be obtained are presented, with a brief discussion pointing out the distinguishing features of each. (auth)

340 TID-6679

[Oak Ridge Gaseous Diffusion Plant, Tenn.].

THE EFFECTS OF INCREASING MASS SPECTROMETER ION ACCELERATING VOLTAGES. A. Langdon and W. G. Hart. Feb. 24, 1960. 7p. (KL-717). OTS.

The ion accelerating voltage was increased on several Nier type uranium-isotope mass spectrometers, which were operating at ~1600 volts, to evaluate the effects of such a change. The accelerating potentials of several spectrometers were raised to 2000 volts, and others to 2500 volts, at relatively slight expense. Ion current intensity and resolution improvements were detectable, and achievement of minimum operating standards was facilitated. Any over-all precision improvements were too small to be distinguishable from other normal fluctuations in the precision levels. (W.L.H.)

341 UR-576

Rochester, N. Y. Univ. Atomic Energy Project.

A FOUR-CHANNEL CONTINUOUSLY RECORDING MONITOR FOR AIR-BORNE ALPHA-ACTIVITY. D. A. Morken and R. H. Wilson. July 13, 1960. 31p. Contract W-7401-eng-49. OTS.

An air monitor is described which samples air-borne radioactivity at remote locations and records the α activities on a strip chart recorder at a central location. Automatic range and time-constant switching is provided. (auth)

342 WAPD-BT-19(p.31-49)

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

EXPERIMENTAL AND THEORETICAL ANALYSIS OF THE TRANSIENT RESPONSE OF SURFACE BONDED THERMOCOUPLES. E. R. Quandt, Jr. and E. W. Fink.

An analysis of the transient temperature excursion of an

insulated, electrically heated plate is presented. A transfer function form for evaluation of the response of thermocouples attached to the plate is analytically developed. Experiments using these combined techniques are described, resulting in a plate-thermocouple system of known transient response. (auth)

343 CEA-tr-R-859

MONTAGE POUR LA DÉTERMINATION DU RÉGIME OPTIMUM DES PHOTO-MULTIPLICATEURS. (Apparatus for Determining Optimum Region for Photomultipliers). A. N. Svenson. Translated into French from Pribory i Tekh. Ekspt. No. 2, 103-4(1958). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract No. 16530.

344 JPRS-5354

A RADIO-FREQUENCY MASS SPECTROMETER (THEORY, CALCULATION, AND DESIGN). A. N. Vorsin, E. (Ye.) F. Doil'nitsyn, A. I. Trubetskoi (Trubetskoy), and M. Ya. Shcherbakova. Translation of "Radiochastotni Mass-Spektrometr." A publication of the Publishing House of the Academy of Sciences, U.S.S.R., Moscow, 1959. 107p. OTS.

A description of a Benneth-type mass spectrometer is given. Theory and calculations are indicated for use with high-frequency signals of various forms. A brief description of the technology of producing the radio-frequency mass spectrometer is furnished, together with a discussion of the results of tests of the instrument and the selection of its operating modes. (W.L.H.)

345

CONSTRUCTION OF GEIGER-MÜLLER COUNTERS WITH A FRONTAL WINDOW FOR BETA-RADIATION. M. Weiner. Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz. 11, 467-8(1960). (In Rumanian)

G-M counters having 20-mm diameter mica windows and graphite cathodes were constructed, filling them under a pressure of about 450 mm of mercury. The thickness of the windows was 6 mg/cm^2. The distance between the window and the glass sphere was kept at 2 to 3 mm. In vertical position the background level of the counters was below 100 cpm while their operating voltage was kept at 1300 to 1400 volts. (TTT)

346

STUDY OF CERTAIN ISOTOPIC EFFECTS BY MEANS OF THE PADDLE-TYPE MICROMANOMETER. V. Mercea, I. Ursu, and D. Barbu. Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz. 11, 468-78 (1960). (In Rumanian)

The previously described apparatus (this Journal, 11, 215-20(1960), No. 1) was used for determining the total amount of an isotope that participated in an exchange reaction. The exchange between gaseous hydrogen and heavy-water steam was investigated, saturating the gas at 98°C and equilibrating it at 132°C under dynamic conditions. The deuterated gas mixture of H_2, HD, and D_2 was cooled in 3 steps and was introduced into the micromanometer, comparing it with pure natural H_2. The isotope effect could be detected with greater ease by increasing the flow rate of the H_2. Future studies will take into account the viscosity changes occurring as a function of the concentration changes of the isotopic species. (TTT)

347

SOME THEORETICAL PROPERTIES OF THE DOUBLE-CRYSTAL SPECTROMETER USED IN NEUTRON DIFFRACTION. B. T. M. Willis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Acta Cryst. 13, 763-6(1960) Oct. 10. (In English)

A treatment is given of the angular dependence of certain intensity functions that are important in spectrometer design. It provides a basis for the choice of various parameters, including the Bragg angle of the crystal monochromator. (auth)

348

RECTIFICATION OF PHOTOELECTRIC SPECTROMETER. Kazimierz W. Ostrowski (Mining and Foundry Academy, Krakow). Acta Phys. Polon. 19, 319-27(1960). (In English)

Formulas are derived for the tolerance of the disposition of the spectrometer camera exit-slit. Other formulas accounting for the curvature of the spectral line set a limit to the admissible height of the exit-slit. A practical rule for the rectification of the spectrometer is also given, the principal feature of which consists in the use of the Hartmann diaphragm. From higher order diffraction, the effect of neighboring lines on the data recorded is assessed. Computation is adapted to a specific spectrograph. (auth)

349

MEASUREMENT OF THE SLOW NEUTRON SPECTRUM OF A NEUTRON BEAM FROM THE WWRS REACTOR BY MEANS OF A CRYSTAL NEUTRON SPECTROMETER. D. A. O'Connor and J. Sosnowski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Acta Phys. Polon. 19, 329-38(1960). (In English)

The efficiency of a crystal neutron spectrometer was determined experimentally using a double crystal arrangement. On the basis of these results the slow neutron spectrum of a neutron beam was determined in the range of neutron wavelength 0.5 to 2.5 A. The variation of crystal reflectivity with wavelength was compared with a theoretical expression for this dependence. (auth)

350

CALIBRATION OF BETA DOSIMETERS. W. Burkhardt and D. Herrmann (Institut für Angewandte Radioaktivität, Leipzig). Atomkernenergie 5, 324-32(1960) Sept. (In German)

For various pure β-ray emitters, the dose distribution around point sources in homogeneous materials is calculated according to a theory of Spencer. A short survey is given on the methods of absolute measurement of β doses. A special method is described in which a "wall-less" ionization chamber is realized by measurements with various wall thicknesses and extrapolation to zero wall thickness. This method is used for calibration of β-sensitive pocket ionization chambers, for absolute measurement of the point source dose functions of W^{185}, Tl^{204}, and P^{32}, and for determination of the absolute activity of point sources of pure β-ray emitters. (auth)

351

A SIMPLE MULTICHANNEL PULSE-HEIGHT ANALYSER. V. F. Mikhailov. Atomnaya Energ. 9, 217-19(1960) Sept. (In Russian)

Descriptions are given of a device with an automatic recording potentiometer. The energy distribution curve obtained by the device for pulses of U^{234} and U^{238} α particles is plotted. (R.V.J.)

352

BASIC RELATIONS FOR THE CONSTRUCTION OF MECHANICAL NEUTRON SELECTORS. Juna Jaromir (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Československ. časopis pro fysiku 8, 529-99(1958). (Translated from Referat. Zhur. Fiz. No. 4, 1960, abstract No. 7863)

Equations are derived for calculating the principal parameters of mechanical neutron selectors. An estimate is made of the aperture ratio. The shortest transit distance necessary to use all the time-analyzer channels was also determined.

353

TRANSISTOR DRIVE CIRCUITS FOR DEKATRONS. K. S. Patel and B. M. Banerjee (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys. 34, 293-8(1960) July.

Transistor drive circuits were described for GC10/4B dekatrons by Chaplin and Kandiah (1958). These applied paired pulses of 80 μsec duration and 80 volts amplitude to the dekatron guides and claim a resolving time of 300 μsec. A transistor circuit suitable for the faster GC 10D dekatron, which attains a resolving time of 40 μsec, is described. This supplies a 20-μsec 150-volt pulse and is essentially a blocking oscillator pulser using a ferrite core transformer. The transformer design details are also described. The circuit is simple and reliable and works over a supply voltage range of 7.5 to 18 volts. The current drain at pulse rate of 5000 is only 2.0 ma at 12 volts. This is strikingly low since the current drain for a paired pulse drive circuit is 10 ma at a pulse rate of 500 only. A similar circuit for GC 10B, which needs 60-μsec pulses, was developed. At 5000 pulse rate its current drain is 12 ma at 12 volts supply. This circuit also works over a range of 7.5 to 18 volts. It is essentially more simple and reliable than the paired pulse drive circuits and shows a resolving time (200 μsec) that is better than the manufacturers figure for this dekatron. (auth)

354

ELECTRONIC INSTRUMENTATION IN NUCLEAR POWER PLANTS. R. Wahl (Société Intertechnique, Paris). Inds. atomiques 4, No. 7-8, 71-3(1960). (In French)

Nuclear instrumentation is developed for its own particular aims. Some electronic functions have been designed whose juxtaposition permits different measurements of nuclear physics or of control. The complexity of these apparatuses has brought this technique closer to that of computers and automation. Some recent examples showing the direction of this evolution are shown. (tr-auth)

355

FIXING AND FIXER FORMULA FOR THICK NUCLEAR PLATES ELIMINATING THE CORROSION OF SILVER GRAINS. H. Braun (Laboratoire de Physique Corpusculaire, Strasbourg). J. phys. radium 21, Suppl. to No. 7, 73A-8A(1960) July. (In French)

The corrosion of the silver grains in thick nuclear plates may be due to several causes such as the composition, the pH, the silver potential, the redox potential, and the volume of the fixing bath. These were investigated. A method is proposed of fixing and a formula for the fixing bath containing ascorbic acid, which makes it possible to obtain thick nuclear plates free of corrosion and perfectly transparent. (auth)

356

THE USE OF CYCLOPROPANE VAPOR IN GEIGER-MÜLLER COUNTERS. Daniel Blanc and Jean Cabé (Centre de Physique Nucléaire, Faculté des Sciences, Toulouse, France). J. phys. radium 21, Suppl. to No. 7, 92A-6A(1960) July. (In French)

Externally graphited glass counters, filled with cyclopropane and argon, have a plateau length of 100 to 200 volts and dead times half those given by argon and methylal fillings under the same pressures. However, the cyclopropane pressure must be above 2 cm of mercury, for the slope of the plateau curve to be less than 5% per 100 volts. Pure cyclopropane vapor will give very long plateau curves (length >600 volts) with a very smooth slope (<1% per 100 volts), with pressures between 25 and 30 cm of mercury. With γ rays (1 Mev), the efficiency is equivalent to that obtained with the usual fillings of argon and polyatomic vapor. Recovery times of detectors filled with mixtures of argon and cyclopropane were evaluated by the oscillographic method, to deduce the k_c value of the mobility of cyclopropane ions. Under atmospheric pressure $k_c = 0.87 \pm 0.05$ cm^2 s^{-1} V^{-1}. The mobility k_a of argon ions was calculated in the same way. Under atmospheric pressure $k_a = 1.30 \pm 0.05$ cm^2 s^{-1} V^{-1}. Similar measurements made with pure cyclopropane confirm that the Stever formula remains valid for such fillings and give for k_c an identical value, within instrumental errors. (auth)

357

DESIGN OF A NEW TYPE OF SELF-TRIGGERING WILSON CLOUD CHAMBER WITH VARIABLE PRESSURE. PART II. Toshiko Yuasa, Guy Corbe, and Fernand Reide (Laboratoire de Physique Nucléaire, Orsay, France). J. phys. radium 21, Suppl. to No. 7, 123A-8A(1960) July. (In French)

The description of the self-triggering electronic system and some characteristic data of a new type of Wilson cloud chamber for very low pressures are given. (tr-auth)

358

TIME-SORTER FOR USE IN THE NANOSECOND RANGE. G. Jones (Univ. of British Columbia, Vancouver). J. Sci. Instr. 37, 318-23(1960) Sept.

The design is given of a time-to-amplitude conversion circuit employing delayed fast coincidence techniques for use in the nanosecond region. This circuit has a linear time calibration of 1 to 10 ns, a resolution time of less than 0.05 ns, and a variation of time calibration less than 0.03 ns per day is achieved. A resolution time of 0.8 ns was found when detecting coincidence between γ rays from a Co^{60} source. (auth)

359

RATIOMETER FOR LOW-CURRENT MASS SPECTROMETRY. F. D. S. Butement and N. P. Finkelstein (Univ. of Liverpool). J. Sci. Instr. 37, 328-32(1960) Sept.

A technique for the measurement of isotopic abundance ratios was developed. Individual ions in the beam are detected, and an automatic switching device counts the total number of ions in each of the two mass beams being compared. The system is simple to operate and was found to give very accurate results. No elaborate stabilization of ion-source emission or other operating conditions is necessary. (auth)

360

REDUCTION OF DEAD-TIME IN HALOGEN-QUENCHED GEIGER COUNTERS. B. B. Trott (University Coll., Cardiff, Wales). J. Sci. Instr. 37, 336-9(1960) Sept.

A type of charge-reduction was found with a halogen-quenched x-ray Geiger counter. A practical circuit was developed which reduces the effective dead-time of the counter by a factor of 10. The dead-times were measured by a new method. (auth)

361

HEAVY-WATER ELECTROLYSIS UNIT FOR GENERATION OF DEUTERIUM GAS PROVIDED WITH AUTOMATIC SWITCH-OFF SAFETY DEVICES. P. K. Dutt (Saha Inst. of Physics, Calcutta). J. Sci. Instr. 37, 352-3(1960) Sept.

An electrolysis apparatus was constructed for the safe and trouble-free generation of deuterium gas from heavy

water for experimental purposes. It was found particularly suitable for introducing the gas at a rate of milliliters per minute (S.T.P.) into a vacuum system without the use of an extra pumping unit, because the electrolysis is done under atmospheric-pressure and not in a vacuum. The apparatus is equipped with electrical control relays and needs little attention. It operates within a specified pressure range of the liberated deuterium gas, and is automatically shut off if the pressure exceeds a certain value. There is an almost complete absence of danger of explosion arising from the electrical devices should the generated deuterium gas be accidentally mixed with air. (auth)

362

AUTOMATIC SILVER CONCENTRATION CONTROL FOR NUCLEAR EMULSION FIXING BATHS. E. Dahl-Jensen (Univ. of Copenhagen). J. Sci. Instr. 37, 360-2(1960) Sept.

An electrometric method is described in which the potential between a silver electrode and a calomel electrode in the hypo bath is used to determine the silver content. The circuit used to maintain the silver concentration at a fixed level is described. (B.O.G.)

363

SOFT ULTRA-VIOLET PHOTONS IN SELF-QUENCHING GEIGER-MÜLLER COUNTERS. Rafi Mohammed Chaudhri and Rahmat Ullah (High Tension and Nuclear Research Lab., Lahore, West Pakistan). Nature 188, 131-2(1960) Oct. 8.

In a self-quenching Geiger-Müller counter filled with an argon-alcohol mixture both photo-ionization and photo-emission cause the spread of the discharge along its anode. The production of ultraviolet photons that are responsible for the processes and their relative importance in determining the counter characteristics are not fully understood. Some workers believe that soft photons are not an important factor in the spread of the discharge. Conclusions reached in the present work are: (1) soft uv photons energetic enough to liberate photoelectrons from the counter cathode are produced in the counter by the recombination of argon ions; (2) uv photons have a much smaller absorption coefficient in alcohol than is usually assumed; and (3) the photoelectric efficiency of a self-quenching counter is dependent on its over-voltage, a point of considerable interest in the operation of the tubes. (B.O.G.)

364

AUTOMATIC EQUIPMENT FOR THE COLLECTION AND PROCESSING OF DATA FROM GEIGER-MÜLLER COUNTERS. Richard Scott (King's Buildings, Edinburgh). Nature 188, 161(1960) Oct. 8.

Automatic equipment was devised for the collection and preliminary processing of information in radioisotopic investigations of ion accumulation processes in marine algae. A description is given of the method for the collection and processing of the data obtained by Geiger-Müller counters placed above the algal sections containing cavities through which the radioisotope containing seawater under study is rapidly circulated. The equipment was designed specifically to deal with tape-recorded data, but it can be used for routine Geiger counting wherever large numbers of samples have to be dealt with. (B.O.G.)

365

AN IRON-FREE BETA-RAY SPECTROMETER FOR ELECTRON-ELECTRON COINCIDENCES. Jose O. Juliano (Philippine Atomic Energy Commission, Manila). Philippine J. Sci. 88, 185-216(1959) June.

A description is given of two thin-lens iron-free β-ray spectrometers that were joined back-to-back at their source ends for electron-electron coincidence spectroscopy. For increased flexibility, the instrument was designed to be easily converted into a γ-electron coincidence spectrometer by placing a canned NaI(Tl) crystal at the back of the source through a long iron pipe and using one of the spectrometers as a regular β-ray spectrometer. Tests used to determine the operating characteristics of the spectrometer are discussed. Electron-electron coincidence measurements were conducted for Bi^{207}, Hg^{203}, and Eu^{154}. The results obtained seem to indicate a possible use in the field of nuclear spectroscopy. (B.O.G.)

366

INVESTIGATION OF THE TIME RESOLVING POWER OF PHOTOELECTRON MULTIPLIERS BY A METHOD OF OSCILLOGRAPHING. A. G. Berkovskiĭ and V. G. Pol'skiĭ. Radiotekh. i Elektron. 5, 1475-7(1960) Sept. (In Russian)

A method is suggested for measuring photomultiplier resolving time with an oscillograph and periodic nanosecond light pulses. The results of time parameter measurements on photomultipliers are quoted. (tr-auth)

367

DISCRIMINATION OF ELEMENTARY PARTICLES IN A SCINTILLATION COUNTER. Emilio Gatti (Centro Informazioni Studi Esperienze, Milan). Rend. seminar. mat. fis. Milano 31, 1-8(1960). (In Italian)

A mathematical study is made of the possibility of particle discrimination in the information supplied by a scintillator. (T.R.H.)

368

SOURCE OF SUPPLY FOR IONIZATION MANOMETER WITH INSTRUMENT FOR THE MEASUREMENT OF THE ION CURRENT. Milan Neuzil (Charles Univ., Prague). Slaboproudý obzor. 20, 382-4(1959). (Translated from Referat. Zhur. Fiz. No. 4, 1960, abstract No. 9306)

A detailed description is given of a device that insures stabilization of both the emission current of an ionization manometer and the supply voltage. An instrument is also described for the measurement of the ionization current within the range 1×10^{-2} to 1×10^{-9} amp, connected in a bridge circuit with two triodes.

369

DEVELOPABILITY OF PHOTOGRAPHIC LATENT IMAGE PRODUCED BY GAMMA-RAY IRRADIATION. Yoshitada Tomoda and Takaaki Ohtsu. Tokyo Kôgyô Shikensho Hôkoku 55, 235-40(1960) July. (In Japanese)

The rate of development of motion-picture positive emulsion exposed to gamma rays emitted from radioisotope Co^{60} was studied. Experiments with an energetic metol-hydroquinone developer showed that the rate of development of latent image produced by gamma rays was smaller than that produced by normal light exposure. This phenomenon can be explained by the extension of the Cabannes-Hoffmann effect, which is concerned with the dependence of the rate of development upon the intensity of light exposure. The light exposure at higher intensity corresponds to gamma-ray irradiation in this experiment. As to the development of internal latent image, no difference in the development characteristics was observed between the gamma-ray exposure and the light exposure. This suggests the importance of the rate of solution of silver halide grains in the development kinetics. Finally, temperature coefficients of development indicated that the activation energy of surface development was not different in the different types of exposure such as gamma

rays or the light, but varied with compositions of developer solutions. (auth)

370

ON THE PREPARATION OF NUCLEAR EMULSIONS N-2 AND N-3. Zah-wei Ho, Tsu-yenz Lou, and Han-tcheng Sun (Inst. of Atomic Energy Research, Academy of Sciences, China). Wu Li Hsüeh Pao 15, No. 3, 131-8(1959). (Translated from Referat. Zhur. Fiz. No. 3, 1960, abstract No. 5208)

Certain questions connected with the process of preparation of nuclear emulsions, which are sensitive to ionization produced by protons, are discussed. The regulation of the concentration of the bromine ions during the time of preparation of the emulsion made it possible to obtain silver-bromine grains that were homogeneous in size. To increase the sensitivity, the optimal conditions of preparation were chosen, and the sensitizer, triethanolamine, was introduced directly before pouring. The regression of the latent image was slowed by adding gold salts to the emulsion. To improve the transparency of the emulsion, purified gelatin was used. At the present time it is possible to obtain nuclear emulsions with uniform properties, sensitive to ionization produced by protons. In their characteristics, these emulsions are similar to "Ilford C-2" used in nuclear research.

371

METHODS OF PREPARATION AND CHARACTERISTICS OF NUCLEAR EMULSIONS. Isu-yeng Lou, Han-tcheng Sun, Hei-tchang Leu, and Zah-wei Ho (Inst. of Atomic Energy Research, Academy of Sciences, China). Wu Li Hsüeh Pao 15, No. 3, 139-44(1959). (Translated from Referat Zhur. Fiz. No. 3, 1960, abstract No. 5209)

Data are reported on certain nuclear emulsions that can be prepared by simple laboratory methods. The characteristics of these emulsions are compared with the characteristics of the Ilford nuclear emulsions. The properties of proton-sensitive emulsions N-2 and N-3 are approximately the same as the properties of Ilford C-2. The N-2 nuclear emulsions that contain bromine or lithium and which are intended for the registration of thermal neutrons, apparently have better properties than the Ilford C-2 emulsions containing bromine or lithium. The sensitivity of the electron-sensitive emulsion N-4 is of the same order as that of the emulsion "NIKFI R" and Ilford G-5. The properties of supersensitive electron-sensitive emulsion N-5 are discussed.

372

CHEMICO-SPECTROGRAPHIC QUANTITATIVE DETERMINATION OF SMALL AMOUNTS OF MOLYBDENUM AND TUNGSTEN IN IGNEOUS ROCKS. L. I. Pavlenko (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim. 15, 463-6 (1960) July-Aug. (In Russian)

A method is suggested for the quantitative determination of small concentrations of molybdenum and tungsten in various rocks. When the concentrations of these elements are greater than 10^{-4}%, the analysis of rocks is carried out by the direct spectrographic method. The analysis of rocks containing less than 10^{-4}% of molybdenum and tungsten is performed with the preliminary chemical enrichment by means of organic co-precipitants. The concentrates obtained are analyzed by the spectrographic method. The sensitivity of the chemico-spectrographic method developed for the determination of molybdenum and tungsten appears to be equal to 2×10^{-4}% and 3×10^{-5}%, correspondingly. (auth)

373

ON THE PRINCIPLE OF TIME MEASURING. L. A. Khalfin. Zhur. Eksptl'. i Teoret. Fiz. 39, 504-6(1960) Aug. (In Russian)

A "nuclear" method is suggested for measuring the time of a number of radioactive nuclear decays or particle decays. The apparatus consists of a source, a transducer for recording decay products, an electron computing device, and a computer calibrated in units of time. The stability of these "nuclear" hours exceeds the stability of atomic or molecular hours, and external conditions do not affect the probability of nuclear transitions. It is pointed out that the longer the time of operation the more accurate the measurement. The limitations of the method are also discussed. (R.V.J.)

374

Gt. Brit. National Physical Lab., Teddington, Middx., England.

A DIPHENYL ETHER CALORIMETER FOR MEASURING HIGH TEMPERATURE HEAT CONTENTS OF METALS AND ALLOYS. Ralph Hultgren, Peter Newcombe, Raymond L. Orr, and Linda Warner (Univ. of California, Berkeley). Paper No. 1H of "The Physical Chemistry of Metallic Solutions and Intermetallic Compounds. Proceedings of a Symposium held at the National Physical Lab. on 4th, 5th, and 6th June, 1958." Univ. of California I. E. R. Reprint No. 17-60 (M.R.L. Contribution No. 95). 1960. 8p.

A diphenyl ether Bunsen-type calorimeter was designed and applied to the determination of heat contents of metals. It proved to be much less expensive and simpler to operate than the more usual type and has comparable accuracy (±10 cal/g-atom platinum). The instrument was calibrated and heat losses of the specimen during the drop evaluated. (auth)

375

IMPROVEMENTS IN ELECTRON BEAM DISCHARGE APPARATUS. (to General Electric Co.). British Patent 849,453. Sept. 28, 1960.

An electron beam discharge apparatus for high-voltage operation is described comprising an elongated insulating envelope with an electron-emitting cathode at one end and an anode assembly at the other end. The envelope in the vicinity of the anode is of flattened funnel-shaped cross section, flaring outward; supporting ribs surround the funnel-shaped wall. The anode itself is a windowpane of stainless steel or titanium foil 4 to 6 mils thick and of an inwardly bowed condition to partially allow for deformation due to vacuum inside the envelope. (D.L.C.)

376

IMPROVEMENTS IN OR RELATING TO APPARATUS PROVIDING A STABLE ORBIT FOR CHARGED PARTICLES INCLUDING AN INJECTION DEVICE THEREFOR. Peter Clive Thonemann (to United Kingdom Atomic Energy Authority). British Patent 849,897. Sept. 28, 1960.

An apparatus providing a stable orbit for charged particles from an injection device is designed wherein a larger number of the injected particles reaches the stable orbit in the toroidal vessel; this is done by a wave guiding structure which propagates an electromagnetic wave in a curved path at such a phase velocity that particles trapped by the wave are accelerated or decelerated until they reach the stable orbit. The structure may comprise a plurality of electrodes extending around the vessel and connected to points on a delay line so that a traveling r-f electric field extends into the outer periphery of the vessel, or it may comprise a flat

serpentine conductor wrapped on the outer periphery of the inside surface of the vessel. In this way, high electric currents may be obtained which are useful in achieving temperatures high enough to bring about nuclear reactions in the medium, e.g., deuterium. (D.L.C.)

Materials Testing

377 ORNL-2988(p.341-405)
Oak Ridge National Lab., Tenn.
METALLOGRAPHY. R. J. Gray, G. Hallerman, et al.

Additional special equipment was developed to extend the capabilities of metallographic investigation. Micro and macro hot-hardness testers were completed and tested for use with vacuum and inert atmospheres up to 900°C, and ultrasonic-chisel techniques were refined. These investigational tools now take their place with electron microscopy and dilatometry. Effort was concentrated in cooperating with the Engineering Division in developing remote metallographic equipment for the High Radiation Level Examination Laboratory. A full-scale mock-up cell now provides a test facility for testing remote vibratory polishing equipment. The increasing requirements for ceramic materials in reactors have placed a demand for the extension of metallographic techniques to ceramographic studies. For example, a very satisfactory polish and etching procedure was developed to reveal the grain size of ThO_2. The main manpower effort continues in the metallographic support for the various reactor programs in the Metallurgy Division. During the period covered by this report, the Metallography Section processed over 5000 specimens, made over 6000 photographs and photomicrographs, and made approximately 1800 lantern slides. (auth)

378 ORNL-2988(p.406-20)
Oak Ridge National Lab., Tenn.
NONDESTRUCTIVE TEST DEVELOPMENT. J. W. Allen, Jr., R. A. Nance, et al.

A new transistorized eddy-current instrument, the Metal Identification Meter, for the sorting of metals and alloys according to their electrical conductivity and magnetic permeability, was designed and built by the Instrumentation and Controls Division in conjunction with the Nondestructive Test Development Group. This lightweight instrument offers several advantages over its predecessor. A new eddy-current instrument was designed and developed for use with probe-coil techniques. A feature of this equipment is its insensitivity to the probe-to-sample spacing. Investigation is continuing of the fabrication of realistic, reproducible standards for tubing inspection. The most promising technique thus far is electrical spark-discharge machining which can produce outside-diameter notches with a depth accuracy of 0.0002 in. Equipment and techniques were developed for using the eddy-current "lift off" effect for the measurement of fuel-element spacing in the High Flux Intensity Reactor core. Effort was directed toward the inspection-development requirements for the Experimental Gas Cooled Reactor fuel element. Techniques were recommended for the fuel-element components and the capsule-closure weld. Studies of ultrasonic behavior in thin sections are being expanded to include quantitative measurements of reflection, transmission, and Lamb-wave propagation as a function of variation in metal thickness and the ultrasonic frequency and incident angle. Instrumentation is being calibrated for frequency response, and equipment was assembled which will permit complete freedom of movement for the transducers. Studies of exposure requirements for helium and air atmospheres for low-voltage radiography demonstrated the advantage of the helium atmosphere. Specific techniques were developed for the radiography of certain beryllium and graphite shapes. Nondestructive-testing techniques are being developed for the inspection of beryllium tubing. These techniques are being applied to the evaluation of a quantity of tubing which was received from American, British, and French sources. Ultrasonic techniques were used to measure the wall thickness of the Zircaloy-2 core vessel for the Homogeneous Reactor Test. Utilization of several electronic instruments permitted a digital presentation of the thickness. Successive measurements indicated a slight decrease in the average wall thickness. A preliminary investigation was made on the use of ultrasonics for weld inspection in thick plates. Correlation was good between inspection results and defects located in sectioned areas of the weld. Equipment was modified and techniques were developed for the assay of U^{235} content in Al-U fuel-element core blanks. Good correlation was obtained between instrument measurements and analytical chemistry results. A number of short-term inspection and evaluation problems were solved during the past year. These included niobium tubing, stainless-steel-clad fuel rods, and the measurement of buried bolts. (auth)

379 WAL-TR-118.1/1
Watertown Arsenal Lab., Mass.
ULTRASONIC DETERMINATION OF ELASTIC CONSTANTS AT ROOM AND LOW TEMPERATURES. Norbert H. Fahey. Apr. 1960. 15p. (PB-161514). OTS.

Using ultrasonics, certain elastic properties of materials can be determined in a nondestructive test, which means that tests can be conducted on a finished product. With a machine that operates within the range of frequencies of 1 to 9 Mc_s, bulk, shear and elastic moduli, and Poisson's ratio can be determined. Tests were conducted at room temperature to −452°F on steel, aluminum, molybdenum, magnesium, lead, Inconel, chromium, Monel, tantalum, columbium, brass, bronze, copper, carbon, plastic, and three titanium alloys. (auth)

380 WAPD-BT-19(p.51-7)
Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.
MISHAWAKA TEST LOOP OPERATIONS. S. Torma.

The Mishawaka Test Loop was established for testing relief valves. The principles of operation and a description of the loop and its water, steam, and cold testing facilities are contained. (C.J.G.)

381

IMPROVEMENTS IN OR RELATING TO METHODS AND APPARATUS FOR DETERMINING THE ECCENTRICITY OF TWO NORMALLY CONCENTRIC CYLINDERS OF DIFFERENT MATERIALS. John Laban Putman (to United Kingdom Atomic Energy Authority). British Patent 847,129. Sept. 7, 1960.

A method is described for determining the eccentricity of two nominally concentric cylinders of different materials without cutting and can be used to test the concentricity of insulating sheath and conductor in insulated cables. The method consists of passing a divergent pair of collimated gamma beams through the sheath and comparing the transmitted beam intensities, the angle of the beams being adjusted so that, if the conductor is concentric with the sheath, the beams just intersect the edges of the conductor. The apparatus for putting this method into effect comprises a lead block with cavities for the cable and radioactive source (Tm^{170}) with diverging holes running from the source through the cable cavity to the surface,

where the beams are detected with Geiger counters. Another pair of diverging holes with associated radioactive source may be located in the lead block with their mean direction at right angles to that of the first pair. (D.L.C.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

382 HW-63832

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SEISMOLOGICAL INVESTIGATIONS AT THE HANFORD AREA, 1958-1959. Frank Neumann. Nov. 10, 1959. Includes reprint: OSCILLATOR RESPONSES TO EARTHQUAKE MOTIONS. Trend Eng. Univ. Wash. 10, No. 4, p.5-10; 24-5(1958). 96p. Contract W-31-109-Eng-52. OTS.

The seismic risk in the Hanford Area was analyzed. The magnitude of seismic disturbances to be expected in the HAPO Area is discussed. Discussions on the motion of the ground during an earthquake, vibration effects on underground and surface structures, and oscillator responses to earthquake motions are presented. Seismological aspects of the earthquake engineering problem are discussed. (C.J.G.)

383 IDO-12015

Weather Bureau, Idaho Falls, Idaho.

DIFFUSION CLIMATOLOGY OF THE NATIONAL REACTOR TESTING STATION. G. A. DeMarrais and Norman F. Islitzer. Apr. 1960. 171p. OTS.

The results of the observational program conducted by the Weather Bureau at the National Reactor Testing Station (NRTS) which are pertinent to the study of atmospheric diffusion are presented. The following elements, as they affect diffusion, are qualitatively and quantitatively summarized: topography, lapse rate and winds, turbulence parameters, solar and terrestrial radiation, and precipitation. In addition the specialized diffusion investigations conducted at NRTS are described. This includes data of both diffusion climatology and diffusion measurements using radioactive and non-radioactive tracers. (auth)

384 TEI-759

Geological Survey, Washington, D. C.

GROUND WATER IN THE OAK SPRING FORMATION AND HYDROLOGIC EFFECTS OF UNDERGROUND NUCLEAR EXPLOSIONS AT THE NEVADA TEST SITE. Alfred Clebsch, Jr. Apr. 1960. 31p. OTS.

Tuff, welded tuff, and tuffaceous sandstone of the Oak Spring formation of Tertiary age overlie unconformably diverse types of Paleozoic rocks. Beneath the major basins of the Test Site the main zone of saturation is in alluvial fill or the Oak Spring, which is an aquifer of moderate to low permeability. Hydraulic gradients are low. Several zones of perched ground water were defined in tuff of the Oak Spring formation near the explosion sites. The Rainier test took place in a unit stratigraphically above a thin, probably discontinuous zone of perched water. The tunnel system for the Logan and Blanca experiments encountered ground water and acted as a drain until the Logan explosion, when flow ceased. Approximately 30 acre-ft of water drained from this tunnel system in about 7 weeks. The Logan site was at or near a perched or semiperched water table; the Blanca site was above the same water table. Water from the Oak Spring formation has a relatively high concentration of silica but otherwise is low in dissolved solids, and the level of radioactivity is low. Hydrologic effects of the explosions involve changes in rock characteristics that directly or indirectly control (1) volume of water in storage, (2) rate and direction of ground-water movement, and (3) chemical and radiochemical equilibrium between the rock and its contained water. The radius of effect is small compared to the probable areal extent of the perched water zone. Analyses of water samples from the zone affected by the Logan explosion and leaching experiments on other radioactive rock indicate that some fission products are taken into solution by percolating ground water. A probably slow rate of ground-water movement, low solubility of the explosion-produced glass, and lag effects due to ion adsorption tend to retard movement of contaminants from the sites. The remoteness of the area further reduces the risk of off-site contamination. (auth)

385 UCRL-6069

California. Univ., Livermore. Lawrence Radiation Lab.

PHYSICAL PROPERTIES OF SALT SAMPLES. Final Report. Raymond S. Guido and Stanley E. Warner. July 15, 1960. 14p. Project COWBOY.

The purpose of Project Cowboy was to investigate the seismic signals generated by chemical explosions in underground cavities, with particular emphasis on the possibility of decoupling of the signals from the surface surrounding media. Results of physical and chemical tests performed on salt samples taken from the Carey Salt Company salt mine are reported. (W.L.H.)

386

CORRELATION OF VOLCANIC ROCKS IN SANTA CRUZ COUNTY, ARIZONA. Omrr J. Taylor (Univ. of Arizona, Tucson). Ariz. Geol. Soc. Digest. 3, 87-91(1960).

A study of the volcanic rocks in Santa Cruz County, Arizona, was made through a compilation of previous works and by new investigations. Microscopic studies revealed the normal assemblage of minerals expected for each rock type except for the olivine basalts, which contained quartz. Each volcanic unit was sampled for chemical testing. Alpha and beta activities were determined in order to estimate Th, U, and K concentrations. Each sample was analyzed for Cr, Cu, Mg, and Ca. (M.C.G.)

387

ARTIFICIAL RADIOACTIVITY IN SPRING AND RUNNING WATER. R. May and H. Schneider (Universität, Giessen, Ger.). Atomkernenergie 5, 333-5(1960) Sept. (In German)

The γ spectra of spring and running water samples were investigated. In spring water the radionuclide Ce^{144} could be identified. In running water the same radionuclides were found as in rainwater samples, among them I^{131}. The isotopes found in these samples were fission products originating from the French Sahara nuclear test explosion of February 13, 1960. (auth)

388

INVESTIGATIONS ON RADIOACTIVE FALL-OUT AND THE ACTIVITY OF THE AIR. [PART] VI. W. Gerlach and K. Stierstadt (Universität, Munich). Atomkernenergie 5, 335-40(1960) Sept. (In German)

Some new results of systematic investigations on different fall-out collectors are given. By an ion exchange method the dissolved radioactive ions in fall-out could be identified as alkaline earths. With this assumption special forms of decay curves were exactly explained. By means of a cylindrical condenser the carriers of natural air activity were separated according to their mobility. The distribution of activity on the spectrum of mobility was investigated. A "rain-drop spectrometer" was constructed to measure the distribution of artificial activity on the

drop-size. The results of fall-out activity during the last years indicate that atmospheric mixture-processes of the latest fission products were finished in June 1959. The total amount of Sr^{90} activity, deposited to the end of 1959, was calculated as 350×10^{-10} cm^2, that is 8% of the total activity of the accumulating device (Sammler). (auth)

389

PRINCIPLES OF CLASSIFICATION FOR COMMERCIALLY VALUABLE URANIUM ORES. P. V. Pribytkov. Atomnaya Energ. 9, 201-7(1960) Sept. (In Russian)

Standard classification principles are suggested for determining the technology and treatment of commercial uranium ores by mineralization, composition, uranium content, valuable admixtures, and structural properties. (tr-auth)

390

RADIOACTIVE TRACERS IN THE ATMOSPHERE. N. G. Stewart. Endeavour 19, 197-201(1960) Oct.

With the advent of thermonuclear explosions, which send clouds well into the stratosphere, the possibility of studying the atmospheric circulation by observing such clouds became apparent. Observations imply that Sr^{90} is returned from the stratosphere to the troposphere in a periodic manner and that the bulk of the material is transferred in middle and higher latitudes. These features must be consequences of the manner in which air is exchanged between the two regions of the atmosphere. It is noted that such movements are consistent with the model for general atmospheric circulation proposed by Dobson and Brewer. Not all meteorologists accept this deduction—there are associated dynamical difficulties—and it may be that the data can be fitted to some more acceptable theory. (B.O.G.)

391

ON THE NATURAL RADIOACTIVITY OF CERTAIN GLASSES. H. Drost and H. Pupke (Inst. of Medicine and Biology, Berlin). Expti. Tech. Physik 7, No. 1, 20-6 (1959). (Translated from Referat. Zhur. Fiz. No. 4, 1960, abstract No. 7893)

Using a counter with a latticed cathode, the radioactivity of glass produced by various German firms was determined. The radioactivity of the glass was due principally to the K^{40} isotope, and in some types of glass also to uranium and Pb^{202}. The activity of most glasses was negligible compared with the natural background. However, in some cases, for example in the preparation of counters, it should be taken into account. The radioactivity of glass that contained uranium was substantially (two orders of magnitude) greater than the activity of ordinary glass.

392

METHODS AND RESULTS OF A STUDY OF RADIOACTIVITY FROM RADON IN NATURAL WATER. G. Jurain (Université, Nancy, France). Geochim. et Cosmochim. Acta 20, 51-82(1960) Sept. (In French)

A field method for the determination of the radon content of natural waters is described. The results obtained in the course of two surveys in different regions of France were analyzed using statistical methods. It appears that: (1) the radon contents are distributed lognormally in a given geological formation; (2) the determination of radon in waters is capable of development into a geochemical prospecting technique, and (3) the radon contents of waters are very often greater than those encountered in biological systems. Systematic studies on the determination of radon in natural waters from different geological formations were carried out for some years (1957–1959) at the Radiogeological Research Centre at the University of Nancy. The research is essentially directed toward the adaptation of methods for use under difficult field conditions as well as their application in very diverse regions. A certain number of results have already permitted some conclusions to be drawn (Roubault et al., 1959), and the present paper continues and completes these. Numerous methods were previously employed for determining radon in waters, atmosphere, rocks, and soils, but they are either already outmoded and slow, such as the ionization chamber (Delibrias, 1954; currently used in the U.S.S.R. for emanometry), or necessitating fragile and delicate equipment difficult to transport from place to place in the field, such as the impulse ionization chamber (Hudgens et al., 1951). Following the work of Damon and Hyde (1952) and of van Dilla, success was attained in utilizing alpha-scintillation counting, with counting tubes, the inside walls of which are coated with zinc sulfide. These tubes are made of glass and comprise the measuring chamber coupled optically to a scintillation detector of the usual type; a reducing scaler completes the apparatus. (auth)

393

ON THE AGE OF PEGMATITES OF THE STANOVOI COMPLEX. A. P. Vinogradov, A. I. Tugarinov, S. I. Zykov, and N. I. Stupnikova (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR and Moscow State Univ.). Geokhimiya No. 5, 383-91(1960). (In Russian)

Results are given of age determination by the lead-uranium-thorium-method of 11 minerals (orthite, zircon, monazite) from pegmatites cutting metamorphous rocks of the Stanovoi complex in the area at the Stanovoi mountain range. Typical of all determinations is one and the same succession of the age values being obtained according to different isotopic ratios: $T\ (Pb^{207}/Pb^{206}) \leq T\ (Pb^{207}/Pb^{235}) \cong T\ (Pb^{206}/U^{235}) > T\ (Pb^{208}/Pb^{232})$. The conclusion is drawn that a relatively constant age value, being obtained according to (Pb^{207}/Pb^{206}), equaling 1900 ± 100 million years, and, coinciding with the values obtained with the aid of the argon-potassium method on micas, is the most probably true age of pegmatites of the Stanovoi mountain range. The minimum age value obtained according to (Pb^{208}/Th^{232}) equaling 430 million years indicates the lower limit of the youngest period of metamorphism. (auth)

394

ON MINERALS-INDICATORS OF BORON CONTENT IN SKARNS. V. L. Barsukov (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Geokhimiya No. 5, 399-404(1960). (In Russian)

A heightened boron content in some skarn minerals may serve as one of the direct signs of considerable boron concentrations being present in the given skarn field. The selectivity of skarn minerals to boron accumulation may be explained by the analogy of the valency state of boron with aluminum and silicon in some of them which is accounted for both by these minerals belonging to definite structural groups of silicates and by their composition. (auth)

395

BORON IN ROCKS AND PEGMATITES OF THE EASTERN SAYAN MOUNTAIN RANGE. O. D. Stavrov and V. G. Khitrov (All-Union Scientific Research Inst. of Raw Materials, Moscow). Geokhimiya No. 5, 405-13(1960). (In Russian)

A method for the spectral analysis of exceedingly low boron contents in silicate rocks, with the use of the

analytical pair B I 2497.73 A/SiO 2498.10 A, is developed which is based on the blowing of the sample powder into the horizontal arc discharge. Data on the boron content in two complexes of rocks, Ar–Prz_1(?) and Prz_{2-3}(?) of the eastern Sayan mountain range, are given. The connection between the tourmaline mineralization in pegmatites, Prz_3(?) and the heightened boron content in parent intrusions is shown. The boron distribution over the rock-forming minerals of the granodiorite sample is given (96% of boron is bound to plagioclase). The presence of boron (0.0001 to 0.0004% of boron) in quartzes from pegmatites with tourmaline mineralization is revealed. Data on the removal of boron from pegmatite veins and its transfer into host rocks are given. (auth)

396

ON THE Zr/Hf RATIO IN ZIRCONS OF SOME IGNEOUS ROCKS OF THE NORTHERN SLOPE OF THE KURAMIN MOUNTAIN RANGE. A. V. Kosterin, I. D. Shevaleevskiĭ, and E. K. Rybalova (Far East Branch of the Academy of Sciences, USSR). Geokhimiya No. 5, 451-4(1960). (In Russian)

Forty-nine zircons of igneous rocks from the northern slope of the Kuramin mountain range were analyzed with the aid of the x-ray-spectral method. It is shown that the Zr/Hf ratio is not only defined by the rock composition but also by the conditions of formation. (auth)

397

ISOTOPIC COMPOSITION OF LEADS FROM PYRITE ORE DEPOSITS OF THE URALS. A. P. Vinogradov, L. S. Tarasov, and S. I. Zykov (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya No. 6, 475-89(1960). (In Russian)

An investigation of the isotopic composition of lead impurity in pyrite-chalkopyrite ores of the Urals was carried out to determine age relations. The main group of the pyrite ore deposits was formed after Lower Carbonic time. Older pyrite ore deposits which are likely to be of Caledonian time were established only in the southern Urals. The similarity of lead isotope compositions of pyrite deposits of the Urals and the Irtish zone of the Altai (post Lower Carbonic age) was revealed. This fact shows that the scheme of their formation processes in both districts was the same, the time being synchronous. (auth)

398

NEUTRON-BOROMETRIC PROFILING. V. I. Baranov, V. K. Khristianov, B. V. Karasev, and S. S. Korobov (Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya No. 6, 490-7(1960). (In Russian)

Detectors of neutrons and gamma quanta together with amplifying schemes are placed on a hydrogen containing reflector of neutrons symmetrically in relation to a Po–Be neutron source. The reflector set on metallic runners is towed by a motor vehicle with a speed of 6 to 8 km/hr. The readings are automatically recorded. A change of boron oxide concentration in the soil by 0.005% causes a change in the counting speed of the neutron counter by 10%. With the aid of a simultaneous record of the neutron flux density and the intensity of the secondary gamma radiation, the change of boron concentration is successfully followed. (auth)

399

COMPOSITION OF THE RARE EARTHS IN GADOLINITES FROM DEPOSITS OF DIFFERENT GENETIC TYPES. E. E. Vaĭnshteĭn, I. T. Aleksandrova, and N. V. Turanskaya (All-Union Inst. of Mineral Raw Materials, USSR and Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya No. 6, 498-505(1960). (In Russian)

The distribution of rare earth elements and yttrium in gadolinites from deposits of four different genetic types was studied by x-ray spectral analysis. It is shown that the character of the distribution of elements in gadolinites (belonging to the number of so called complex minerals) strongly depends on the conditions of formation. The most enriched in yttrium are the gadolinites, the formation of which is connected with granitic and alkaline pegmatites. The richest in cerium are the accessory gadolinites. If albitization processes are developing in gadolinites, an accumulation of yttrium and ceric rare earth elements and a removal of yttric earths occur. (auth)

400

ON THE CORRELATIVE BONDS OF THE RARE-EARTH ELEMENTS AND SOME PECULIARITIES OF RARE-EARTH SEPARATION IN THE PROCESSES OF ENDOGENOUS MINERAL FORMATION. L. S. Borodin (Inst. of Mineralogy, Geochemistry and Crystal Chemistry of Rare Elements, Academy of Sciences, Moscow). Geokhimiya No. 6, 506-17(1960). (In Russian)

The study of variations in the composition of rare earths in a number of minerals of a different genesis (monazite, rinkolite, sphen, apatite, perowskite) with the aid of a correlative "lanthanum" graph shows that in many geochemical processes a division of the rare earths into two groups, "more basic" and "less basic" elements, is observed. Being determined by concrete geochemical conditions, the composition of the indicated groups is not constant. Only in some cases (approximately equal activity of ceric and yttric earths) these groups correspond to ceric and yttric earths. The change in the composition of both groups occurs conjugated which is displayed in the constantly observed multiple correlation—direct and inverse—of all the rare earth elements. The composition of the group of rare earth elements which isolate from the solution determines the possibility of the appearance of selective or complex compositions of the rare earths in the minerals of the same paragenesis. (auth)

401

VOLUME DIFFUSION AS A MECHANISM FOR DISCORDANT LEAD AGES. G. R. Tilton (Carnegie Institution of Washington, D. C.). J. Geophys. Research 65, 2933-45 (1960) Sept.

The discordant uranium–lead ages of sixteen minerals having Pb^{207}/Pb^{206} ages of 2400 to 2700 m.y. closely fit a 2800 to 600 m.y. chord when placed on a Pb^{207}/U^{235}–Pb^{206}/U^{238} diagram. These minerals are from the continents of North America, Africa, Europe, Australia, and Asia. If the data are interpreted as evidence of an episode of loss of lead 600 m.y. ago from minerals that were crystallized 2800 m.y. ago, it is strange that the same time of loss is indicated for all four continents. Most of the samples are from shield areas where no evidence was found for metamorphic events 600 m.y. ago. As an alternative explanation, lead may be considered to diffuse continuously from crystals at a rate governed by a diffusion coefficient (D), the effective radius (a), and the concentration gradient. Calculations of the present-day Pb^{206}/U^{238} and Pb^{207}/U^{235} ratios as a function of the parameter D/a^2 yield ratios that lie on a 2800 to 600 m.y. chord on a Pb^{206}/U^{238}–Pb^{207}/U^{235} diagram for losses of up to two-thirds of the lead produced in the sample. This method is capable of explaining the regularity of the age patterns from one continent to another and does away with the need for episodic losses of lead simultaneously in all the areas 600 m.y. ago. Other examples were found of suites of minerals with discordant ages

which fit this hypothesis; they include minerals with apparent ages of 1900, 1700, and 1100 m.y. The behavior of uranium-lead ages in several zircons from metamorphic rocks is indicative of an activation energy for diffusion of lead of less than 10 kcal/mol over a temperature range of 50° to 400° to 600°C. This inference, when considered with available data for the diffusion of argon from micas, is capable of explaining why uranium-lead ages measured from zircon may be either greater or less than the potassium-argon ages of coexisting mica. (auth)

402

PRINCIPLES OF STRUCTURAL STABILITY OF UNDERGROUND SALT CAVITIES. Shosei Serata (Michigan State Univ., East Lansing) and Earnest F. Gloyna. J. Geophys. Research 65, 2979-87(1960) Sept.

The principles of structural stability of underground salt cavities and the significance of the principles as they relate to other cavities are discussed. The theory of plasticity is applied to the evaluation of stress and strain conditions of the salt cavities. The concept of a yielded zone which develops around the cavities is introduced, and a theoretical development of the extent and stress distribution of the zone is illustrated through the use of ideal spherical and cylindrical cavities under uniform triaxial compression. Applicability of the concept to actual conditions, such as cavity irregularities, brittleness of formation, and nonhydrostatic loading, is discussed. (auth)

403

CONCENTRATION OF SOME FISSION PRODUCT NUCLIDES IN GROUND-LEVEL AIR. K. Edvarson and Kerstin Löw (Research Inst. of National Defence, Stockholm). Nature 188, 125-8(1960) Oct. 8.

In ground-level air the fission product activity originating from nuclear weapon tests varies with time, both in intensity and composition. The variations were mapped using γ-spectrometric measurements made on monthly ground-level air samples taken near Stockholm, Sweden. This activity variation was correlated with known nuclear weapon tests. The results given cover the period September 1957 to December 1959. The measurements were performed at the end of 1959 and beginning of 1960, and the concentrations of Zr^{95}, Sb^{125}, Cs^{137}, and Ce^{144} were determined. Activities calculated to October 18, 1959 are tabulated. (B.O.G.)

404

EXPLOITATION OF MASSIVE DEPOSITS BY THE METHOD OF VACANT MINE CHAMBERS AT INTERMEDIATE LEVELS. G. Chapot (Commissariat à l'Énergie Atomique, Saclay, France). Rev. ind. minèrale 40, No. 11, 13p.(1959) Nov. (In French)

The deposits of the uranium mine at the Ecarpière are in the form of almost vertical veins whose main direction is north 60° west. These veins, which are for the most part irregular, are filled by a breccia (rubble) of granite and syenite highly impregnated with fluorine. The points where there is an enrichment in uranium compounds are widely dispersed and take the form of small veins of pitchblende together with pyrites or of platings of pulverulent black oxides. The enclosing rock consists of fractured granite. In spite of the coating of kaolin in the numerous faults and fractures, the walls are fairly good. Some discordant veins but against the central group of veins. At the meeting points between the discordant veins and the main vein, there is a thickening (up to 20 to 25 m) in the vein over quite a considerable height. These thickenings are very often impregnated by pitchblende, in which case the phenomena is termed a mass. Borings carried out from ground level have shown the presence of these important ore-bearing zones, enclosed in the sound granite, and which give grounds for expecting that from the start of exploitation the walls will hold well. It was therefore possible to envisage almost any method of exploitation. For economic reasons only, the method of exploitation of intermediate levels using unfilled chambers was adopted. Once this method had been adopted, exploratory galleries were opened up so as to determine the boundary of the ore-bearing zone. Half of these galleries were excavated in marginal zones so as to find the limits of the zones to exploit. At the present time, the exploitation of one mass is almost terminated, on another the pillars are being removed, and a third is being reconnoitered. (auth)

405

STUDY CENTER OF GEOCHEMISTRY AND MINERALOGY ACTIVITIES FOR THE TWO YEARS 1957-58 AND 1958-59. Guido Carobbi (Comitato Nazionale per le Ricerche Nucleari, Florence). Ricerca sci. 30, 967-74(1960) July. (In Italian)

A report is presented on the research accomplished by the Center during a 2-year period (1957-59) in the field of mineralogy, crystallography, and geochemistry. The chapter on mineralogy sums up the research effected on Italian minerals of uranium, on the minerals of some sandstones of the Apennines, on the borates of Larderello (Tuscany), on the zeolites of Elba island, on the selensulfur of Vulcano (Eolie islands), and the bauxites of the Nurra (Sardinia). The chapter on crystallography describes the research accomplished on parsonsite, brochantite, humboldtine, and mirabilite. The chapter on geochemistry gives results of the determination of uranium in the volcanic rocks of the paleozoic series of Trentino-Alto Adige as well as results of studies on the granodioritic plutonic rock of Giglio Island and on some samples of dolomitic rock from the mines of Montepon (Sardinia). Some methodologic researches and studies in progress are mentioned. (auth)

406

LOS MINERALES DE URANIO SUS YACIMIENTOS Y PROSPECCION. (Uranium Minerals. Their Ore Deposits and Prospection). Victorio Angelelli. [Buenos Aires], Comisión Nacional de Energía Atómica, 1958. 167p.

A survey is made of the properties and prospection of uranium minerals. The tests for the determination of uranium in minerals and the geochemical position of uranium are discussed. The principal uranium deposits of the world are reviewed, with emphasis on the deposits in Argentina. The use of scintillation counters and Geiger-Mueller detectors in prospection for uranium is described. In an appendix the Argentine laws on nuclear materials are given. (J.S.R.)

HEALTH AND SAFETY

407 A/AC.82/G/L.382

Japan. National Inst. of Radiological Sciences, Chiba. THE RESIDENCE TIME IN THE ATMOSPHERE OF THE DEBRIS FROM ATOMIC TEST EXPLOSIONS. Hironobu Watanabe and Mikio Yamashita. May 1960. 12p.

An analysis was made of the seasonal variation of radioactivity in rainwater to obtain information on residence time of world-wide fall-out in the atmosphere. The radioactivity observed is approximated by $e^{-0.01t}$ during June to Oct. 1959. A mean residence time of about 5 months can be inferred from this. More data from other parts of the world would improve this estimate. (T.R.H.)

408 AERE-R-3448

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A COMPREHENSIVE PUNCH-CARD SYSTEM FOR THE ROUTINE BIOLOGICAL SAMPLING OF PERSONNEL. P. J. Gomm and M. R. Trump. Aug. 1960. 11p. BIS.

A punch-card system is described for regular sampling, at various intervals, of urine from persons working with radioelements. (auth)

409 CEX-57.1

Naval Radiological Defense Lab., San Francisco.

THE RADIOLOGICAL ASSESSMENT AND RECOVERY OF CONTAMINATED AREAS. Carl F. Miller. Mar. 1958. 67p. OTS.

The Civil Effects Test Operation Exercise CEX-57.1 following Operation Plumbbob was carried out to obtain information on decontamination procedures that could be used as radiological countermeasures. The test was conducted on D + 1 and D + 2 days after shot Coulomb C. Data were obtained on reclamation of land areas by scraping with a motorgrader, on fire-hosing and scrubbing a concrete-slab roof, and on fire-hosing a composition roof. In addition, some shielding data were obtained for a small building with 6-in.-thick concrete walls and roof. The conceptual nature of a radiological defense system and the role of decontamination or reclamation in such a system are discussed. Most of the report deals with methods for reducing the observed data to interpretive form because the data were taken within a large contaminated area. The decontamination effectiveness in terms of the fraction of contamination remaining was computed. It is concluded that low levels of contamination at the Nevada Test Site could be utilized to advantage to obtain data on γ-radiation properties, such as the effects of materials and source geometries on the attenuation of fission-product γ rays. However, higher levels of fall-out in terms of the fall-out particle mass, are required to obtain useful information and training on decontamination techniques; therefore the use of low levels of contamination to conduct studies in this area is not recommended. (auth)

410 CF-59-11-133

Oak Ridge National Lab., Tenn.

DISSOLVER OFF-GAS AND RARE GAS PLANT HAZARDS. J. M. Holmes. Nov. 13, 1959. 10p. OTS.

The hazards involved in hydrogen dissolution during sulfex decladding, nitrogen oxide evolution during dissolution with HNO_3, condensation of oxygen in the liquid nitrogen-absorption process, and the compression of rare gases are discussed. Possible solutions to these hazards are considered. (C.J.G.)

411 CRER-938

Atomic Energy of Canada Ltd., Chalk River, Ont.

THE COLLECTION OF SNOW BY ION-EXCHANGE FALL-OUT COLLECTOR. J. E. Guthrie and J. F. MacDonald. 1960. 15p. (AECL-1090).

A description of an ion exchange fall-out collector for monitoring Sr^{90} and Cs^{137} in snow is given. Advantages of the heated fall-out collector are discussed. (C.J.G.)

412 DEG-Report-123

United Kingdom Atomic Energy Authority. Development and Engineering Group, Risley, Lancs, England.

SHIELDING AGAINST CRITICAL EXCURSIONS IN PLANTS PROCESSING FISSILE MATERIALS. P. McKinlay and F. R. Charlesworth. Mar. 29, 1960. 16p. BIS.

Nominal wall thicknesses such as 2 ft of concrete have been mentioned as being sufficient to protect an operator from radiation injury in fissile-material processing excursions. The probable radiation hazard for a standard incident of 10^{17} fissions is defined, and the effects of shielding and prompt operator action are defined. The implications of increasing standard wall thicknesses to a sufficient extent to protect an operator from receiving an emergency dose of 25 r are discussed. (W.D.M.)

413 FFIF-IR-F-104

Norway. Forsvarets Forskningsinstitutt, Kjeller.

RADIOACTIVE FALLOUT IN NORWAY, JULY 1959 TO JULY 1960. T. Hvinden. Aug. 1960. 51p.

A review is given of fall-out monitoring in Norway from July 1959 to July 1960. Although deposition of short-lived and long-lived isotopes during the first 6 months of 1959 was higher than during previous years, concentrations of fall-out materials in air and precipitation thereafter decreased and at the beginning of 1960 were the lowest for many years. From the end of February 1960, some radioactive material from the Sahara weapons tests reached Norway. (auth)

414 HASL-93

New York Operations Office. Health and Safety Lab., AEC.

SUMMARY OF GUMMED FILM RESULTS THROUGH DECEMBER 1959. John H. Harley, Naomi A. Hallden, and Long D. Y. Ong. Sept. 5, 1960. 329p. OTS.

The data for gummed-film fall-out measurements through Dec. 1959 are reported. While the initial purpose of the gummed-film network was to determine the geographic distribution and time of arrival of fall-out, considerable effort has been devoted to computation of Sr^{90} deposition and infinity gamma dose. These latter computations have been satisfactory for the period of observation and furnish data for locations not covered by other types of measurement. Detailed comparisons are made between Sr^{90} estimates from gummed film and analyses made on pot and soil samples. Comparable tests of the gamma-dose estimate are not possible. Summary tables are given for each gummed-film station listing the monthly estimates of Sr^{90} deposition and infinity gamma dose. (auth)

415 HASL-95

New York Operations Office. Health and Safety Lab., AEC.

FALLOUT PROGRAM. Quarterly Summary Report [for] June 1, 1960 through September 1, 1960. Edward P. Hardy, Jr., Joseph Rivera, and Robert Frankel. Oct. 1, 1960. 218p. OTS.

Current information is summarized from the HASL Fallout Program. Information is included from the U. S. Naval Research Laboratory, Los Alamos Scientific Laboratory, and Western Germany. Data that have become available during the period June 1 to September 1, 1960, on radionuclide levels in deposited fall-out and in air, water, bread, and milk are reported. Interpretive reports on the atmospheric content and surface deposition of Sr^{90} are included. The distribution of W^{185} over the earth's surface is also reported. A bibliography of recent literature is presented. (auth)

416 IDO-12013

Idaho Operations Office. Health and Safety Div., AEC.

RADIOLOGICAL ASSISTANCE PLAN. Percy Griffiths and George J. Ball, comps.—John R. Horan, ed. June 1960. 58p. OTS.

Procedures are presented which are to be followed in the event that the AEC Idaho Operations Office is requested to provide assistance following a radiological incident in the area comprising Idaho, Montana, Wyoming, Utah, and Colorado. The emergency organization to execute this function

consists of an emergency monitoring team, medical team, and public information personnel. (J.R.D.)

417 ORINS-38
Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.
THE ORINS HUMAN RADIATION COUNTERS. A Preliminary Report. Marshall Brucer. July 1960. 146p. OTS.

A conceptual design and literature survey are given as preliminary to actual initiation of the project for a human radiation counting installation. Discussions with a very large number of persons knowledgeable in the field are summarized. The possible uses of human radiation counters and the types are discussed. A design and proposal are offered. Incomplete specifications for the crystal and the liquid scintillators are included. (Extensive annotated bibliography.) (T.R.H.)

418 ORNL-2994
Oak Ridge National Lab., Tenn.
HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1960. Oct. 24, 1960. 311p. Contract W-7405-eng-26. OTS.

Progress is reported on radioactive waste disposal, ecological studies, radiation physics and dosimetry, and internal dosimetry. Separate abstracts were prepared for 23 sections of the report. (T.R.H.)

419 ORNL-2994(p.45-57)
Oak Ridge National Lab., Tenn.
CLINCH RIVER STUDIES. F. L. Parker, E. G. Struxness, et al.

A comprehensive study of the Clinch River, downstream from White Oak Creek, was started in cooperation with several state and Federal agencies. The purpose of the study is to obtain fundamental information on the physical, chemical, and biological dynamics of a flowing freshwater ecosystem that is receiving large volumes of low-level radioactive wastes. (auth)

420 ORNL-2994(p.191-204)
Oak Ridge National Lab., Tenn.
RADIATION PHYSICS AND DOSIMETRY. THEORETICAL PHYSICS OF DOSIMETRY. G. S. Hurst, R. H. Ritchie, et al.

Further estimates of the stopping power of heavy ions in tissue were made. An investigation was made of instabilities resulting from the passage of an electric beam through a dielectric medium. A code for the computation of the space-independent slowing-down spectrum of low-energy electrons in an ideal Fermi-Dirac electron gas is nearly complete. A method is proposed for evaluating the energy dependence of the cross section for electron attachment from data on the dependence of this process on applied electric field in swarm experiments with noble gases. Calculations of neutron and γ leakage from some bare critical assemblies that are of interest in the dosimetry of critical accidents were made. A Monte Carlo study of the penetration of γ rays in spherical inhomogeneous media was carried out. Codes were written for the evaluation of the energy response of neutron dosimeters. (auth)

421 ORNL-2994(p.204-25)
Oak Ridge National Lab., Tenn.
EXPERIMENTAL PHYSICS OF DOSIMETRY. R. D. Birkhoff, E. T. Arakawa, et al.

Studies of electron attachment in a mixture of water vapor and argon will lead to the cross section for the dissociation of the water molecule into H^- and OH. Similar experiments in water vapor and carbon dioxide indicate that no dissociation occurs, and that the cross section for direct attachment is small. Measurements of the diffusion of electrons in H_2, N_2, CH_4, and C_2H_4 enabled calculations of the ratios of mean drift velocities to the diffusion coefficients and the ratios of mean agitation energies of the electrons to thermal agitation energies of the gas molecules. The electronic mean-free paths, average energy losses per collision, and collision cross sections were calculated from these data and the assumption of a Druyvesteyn electron-velocity distribution. Measurements of the pulse-height distribution in a proportional counter from single electrons reveal agreement with theory. Calorimetric measurements of electron stopping power in gold at low energies by a null method yield results 20% or more above that predicted by the Bethe theory. A redesign of the calorimeter to reduce scattering effects and improve accuracy was carried out and should enable determination of whether or not the above disagreement is real. A preliminary search for light of 837-A wavelength from electron-irradiated aluminum was made by using an accelerator as a source of electrons and a Seya-Namioka vacuum ultraviolet spectrograph. No sharp line has been found as yet, although the theories of Ferrell and Ritchie predict that the conduction-electron plasma should radiate at this wavelength as it decays to the ground state. To enable further studies of the electron slowing-down spectra in irradiated media, the calculation of the transmission and resolution of the spherical condenser spectrometer for large sources were programmed for the IBM 704, and the favorable results have led to plans for early construction of such an instrument. The strong dependence of the light output of anthracene on the rate of energy loss from an energetic particle traversing this material has suggested that anthracene can be employed in an LET meter. Layers as thin as 0.19 mg/cm^2 were vacuum-evaporated on a photomultiplier and produced usable pulse-height distribution when irradiated with α particles. (auth)

422 ORNL-2994(p.233-41)
Oak Ridge National Lab., Tenn.
DOSIMETRY APPLICATIONS. J. A. Auxier, J. C. Ashley, et al.

Studies to determine the shielding afforded by residences against radiation fall-out were continued. The activation of blood sodium by neutrons was evaluated for dosimetric purposes, and monitoring systems for nuclear accidents were improved. A comprehensive experiment was conducted at the Boris Kidrič Institute in Vinča, Yugoslavia, to determine the radiation exposures of the six persons exposed during an accident in 1958. (auth)

423 ORNL-2994(p.251-5)
Oak Ridge National Lab., Tenn.
INTERNAL DOSIMETRY. ESTIMATION OF INTERNAL DOSE. W. S. Snyder, B. R. Fish, and C. F. Taylor.

The dose from a short-term exposure, or from a single intake of radioactive material, was estimated and compared with the dose from continuous exposure to the same material. It was found that if a continuous exposure level is set so that after 50 years of ingestion at this level the critical organ is exposed at a dose rate of R rems per quarter, then a single intake equal in amount to that ingested during a quarter of continuous exposure will deliver a total dose of R rems to the same organ during the 50 years immediately following the single ingestion. As an aid in the analysis of distribution and elimination data, an iterative curve-fitting procedure, the fractionator method, was derived. The procedure yields tenable estimates of the function parameters and converges in all cases tried, for those forms that have been studied (a sum of exponentials and a polynomial). (auth)

424 ORNL-2994(p.256-64)
Oak Ridge National Lab., Tenn.
SPECTROGRAPHIC ANALYSIS OF HUMAN TISSUE. I. H. Tipton, M. J. Cook, et al.

Data on the variability of the normal distribution of 48 isotopes in humans are being studied. These data were obtained by analysis of normal human tissue by emission spectrometry, neutron activation, and dry-flame photometry. (auth)

425 ORNL-2994(p.264-6)
Oak Ridge National Lab., Tenn.
APPLIED RADIOBIOLOGY. INHALATION STUDIES. B. R. Fish, G. W. Royster, Jr., et al.

Animal inhalation study programs, mentioned in previous progress reports, are complete. In a study of chronic inhalation of U_3O_8 in beagles, it was seen that the concentration of uranium in the lung tends to equilibrate within about 6 to 9 months. The urinary uranium excretion rate may be correlated with the lung burden (the ratio of the equilibrated value of lung burden to the excretion rate is ~520). (auth)

426 TID-6395
Knolls Atomic Power Lab., Schenectady, N. Y.
A SHIELDED CONTAINER FOR TRANSPORTING RADIOACTIVE SPENT FUEL. B. B. Biggs. July 15, 1960. 6p. OTS.

A container for transporting spent nuclear fuel to reprocessing plants is described. The container is safe, readily handled, and reusable. (J.R.D.)

427 UCLA-438
California. Univ., Los Angeles. School of Medicine.
SUMMARY STATEMENT OF FINDINGS RELATED TO THE DISTRIBUTION, CHARACTERISTICS, AND BIOLOGICAL AVAILABILITY OF FALLOUT DEBRIS ORIGINATING FROM TESTING PROGRAMS AT THE NEVADA TEST SITE. Kermit H. Larson and James W. Neel. Sept. 14, 1960. 40p. Contract AT-04-1-GEN-12. OTS.

Summary statements are given of significant findings related to the distribution, characteristics, and biological availability of fall-out debris originating from testing programs at the Nevada Test Site during the past decade. The delineation of fall-out patterns has been accomplished by the use of aerial and ground monitoring surveys. Only about 25% of the total amount of fission products produced by tower-supported detonations were deposited within distances corresponding to fall-out time of H + 12 hr; a much smaller quantity was deposited by balloon-supported detonations. Fall-out particles less than 44 μ in diameter are presumed to be of the greatest biological significance. About 30% of the fall-out radioactivity from tower-supported detonations was contained in the 0 to 44 μ particles as compared to almost 70% for balloon-supported detonations. Fall-out debris from balloon-supported detonations was also much more water and acid soluble than was the debris from tower-supported detonations. The < 44 μ fallout particles contained a higher percentage of Sr^{89}, Sr^{90}, Ru^{103}, and Ru^{106} than did larger sized particles. There was a higher percentage of these radioelements in the particles from balloon-supported detonations. Within distances corresponding to H + 12 hr fall-out time, balloon-supported detonations deposited a maximum of 0.13% of the theoretical total Sr^{89} produced; tower-supported detonations deposited a maximum of 2%. Tower-supported detonations also deposited a maximum of 7.2% of the theoretical total amount of Sr^{90} produced. Beta decay curves approximated the $T^{-1.2}$ decay expression from H + 12 to H + 6000 hr; gamma decay curves deviated to the extent that irradiation doses calculated by the observed decay values were 1.5 to 2 times > those calculated by the $T^{-1.2}$ relationship. Fall-out radioactivity is apparently confined to the first 2 in. of the soil surface unless the surface has been mechanically disturbed. Most of the fall-out debris that was redistributed by various environmental factors after original deposition consisted of particles < 44 μ in diameter; the particles in this size range also represented the predominant contamination on plant foliage. Sr^{89} levels in surface soil ranged from 31.9 to 142 mc/sq. mile in virgin areas near known fall-out pattern midlines and from 7.5 to 22.7 mc/sq. mile in agricultural areas that in some cases did not coincide with fall-out pattern midlines. The accumulation of radioiodine by native animals was observed to be a function of distance from GZ. Ba^{140}, Y^{91}, Sr^{89}, and Sr^{90} were major bone contaminants. Post-series sampling of native animals indicated that the accumulation of Sr^{89} was also a function of distance from the point of detonation; however, the Sr^{90} accumulation by animals correlated poorly with the strontium unit levels in soils. The strontium unit levels increased in milk immediately following contamination of the farm with fall-out debris and then decreased with time as well as the amount of strontium associated with the cattle's diet. Observations during the past decade indicate that less than 10% of the total strontium produced from nuclear detonations at NTS has been deposited within 200 miles from the point of detonation. (auth)

428 AERE-Trans-851
CRITICAL COMMENTS ON THE ESTIMATION OF RADIOACTIVE CONTAMINATION BASED ON THE MEASUREMENT OF TOTAL ACTIVITY. G. Herrmann, H. Hauser, and H. J. Riedel. Translated by F. Hudswell (U.K.A.E.A., Harwell) from Nukleonik 1, 305-14(1959). 33p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 2297.

429 CEA-tr-R-900
CONCENTRATION DES RADIOÉLÉMENTS ARTIFICIELS À PARTIR DE GRANDS VOLUMES D'EAUX NATURELLES. (Concentration of Artificial Radioelements Starting with Large Volumes of Natural Waters). K. F. Lazarev and S. M. Grashchenko (Grashentko). Translated into French from Radiokhimiya 1, 493-6(1959). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 5282.

430 DEG-Inf. Ser.-61
DETERMINING THE AGE OF FISSION PRODUCTS IN THE ATMOSPHERE. F. Ludwieg. Translated by R. Presser (U.K.A.E.A., Risley) from Atompraxis 5, 339-42(1959). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 2291.

431 JPRS-2773(p.126-34)
METHODS OF MEASURING HUMAN RADIOACTIVITY. L. I. Zlobin, A. N. Pisarevskii (Pisarevskiy), E. L. Shapiro, and V. A. Shamov. Translated from Med. Radiol. 4, No. 6, 85-7(1959).

The various techniques for measuring the radioactivity of the human body are discussed, compared, and evaluated. (T.R.H.)

432
GONAD DOSES RESULTING FROM THE USE OF IONIZING RADIATIONS IN FRANCE. I. RADIODIAGNOSIS. J. Reboul, J. Tavernier, Y. Istin, and J. Sorin (Faculté de Médecine, Bordeaux). Ann. radiol. 2, R.179-96(1959). (In French)

Attempts are made to solve the problem of the gonad

doses resulting from the use of ionizing radiations in France. Since the main source of irradiation is radiodiagnosis, this was the first problem to be tackled. This work is based on the analysis of 36,000 individual record sheets drawn up in the hospital departments of the Bordeaux area; these provided all the necessary data for a period of 12 consecutive months. This system enables the various types of examinations to be classified on a percentage basis and also allows the distribution of each type of examination to be expressed in terms of age groups, this being the only method that lends itself to a correct assessment of the genetically important doses absorbed by individuals of under 30 years of age, on a level with the gonads. An extrapolation of the results of this regional inquiry enables a good approximate estimate to be made of the number of radiological examinations carried out in France during the same period. According to these calculations, the total number of examinations effected in France in the course of 1 year, covering the whole of the population, is apparently 6 million. Cross-checks provided by other methods of assessment (area of film used each year, number of appliances) show that the figures obtained give an approximation which is sufficiently accurate to serve as a basis for the calculation of the gonad doses received. (auth)

433

GONAD DOSES RESULTING FROM THE USE OF IONIZING RADIATIONS IN FRANCE. I. RADIODIAGNOSIS (CONTINUED): MEASUREMENT OF THE GONAD DOSES. J. Reboul, J. Tavernier, G. Delorme, Y. Istin, and J. Sorin (Faculté de Médecine, Bordeaux). Ann. radiol. 2, R.571-84 (1959). (In French)

The problem of the gonad doses resulting from various radiological examinations is studied. The variable nature of these doses is insisted on and the figures proposed can be considered only as minimum values, since the measurements were made under optimum manipulation and protection conditions. The problem of the conversion into true ovarian doses of the doses measured at skin level in women is considered. The average values obtained for each type of examination are given; with the aid of the examination distribution tables which appeared in a previous article, this enables the gonad doses to be calculated for the whole of the population of France and for the under-thirty element of this population. Finally, the validity of the calculation method universally chosen is discussed; this consists of establishing an average dose per individual and per year by dividing the total gonad dose by the number of inhabitants in the country. (auth)

434

DETERMINATION OF THE INTEGRAL DOSE IN A HOMOGENEOUS VOLUME OF FINITE DIMENSIONS AND OF DENSITY. [PART] 1. Andrée Dutreix and Maurice Tubiana (Institut Gustave-Roussy, Villejuif, France). Ann. radiol. 2, R.383-8(1959). (In French)

One of the difficulties associated with the measurement of the integral dose is the variations of the dose inside the medium studied and the fact that the dose diminishes to very low values outside the geometric limits of the beam. If it is to be accurate, experimental determination thus necessitates a large number of measurements with instruments with a wide range of sensitivity. These problems can be largely overcome if the integral dose is measured in a cylindrical volume turning about its own axis after it has made a complete rotation. In this case, it is only necessary for measurements to be taken in a single diametrical plane; in addition, variations of the dose in a plane perpendicular to the axis of the cylinder are then smaller. The integral dose determined in this way corresponds to cyclotherapy, but can immediately be used to determine the integral dose in fixed-field irradiation. An account is given of an example of this method of determination, and the results obtained are compared with those provided by various calculation methods. (auth)

435

GONAD DOSES RESULTING FROM THE USE OF IONIZING RADIATIONS IN FRANCE. II. THE PROBLEM OF FLUOROSCOPY. J. Reboul, G. Delorme, J. Tavernier, and M. Geindre (Faculté de Médecine, Bordeaux). Ann. radiol. 3, R.89-99(1960). (In French)

The problem of fluoroscopy and its contribution to the gonad doses received by the population is studied. Fluoroscopic examination is a current medical practice; it makes a considerable contribution to diagnosis and only requires inexpensive apparatus. However, the increase in fluoroscopic examinations in France owing to the development of the social services necessitates that particular attention is paid to stating precisely the essential physical and physiological aspects. This must help perfect the technique of fluoroscopy by minimizing the dangers to patient and operator. It is possible to diminish the number of these investigations by closely examining the question of their need in the framework of social medicine. (auth)

436

THE ENVIRONMENTAL RADIATION DURING RADIODIAGNOSTIC PROCEDURES. A TECHNICAL STUDY FOR THE PROTECTION OF RADIOLOGISTS. F. Santagostini (Hôpitaux de Paris) and S. Santagostini. Ann. radiol. 3, R.197-212(1960). (In French)

The use of isodose curves is given as a means of detecting the areas of danger around radiodiagnostic equipment. The variations in these curves with the different radiological variables are studied. It is suggested that the makers produce the scatter characteristics of their apparatus in the same way as generator characteristics. (auth)

437

GONAD DOSES RESULTING FROM THE USE OF IONIZING RADIATIONS IN FRANCE. III. RADIOTHERAPY. J. Reboul, G. Delorme, Y. Meilhan, J. Tavernier, and M. Geindre (Faculté de Médecine, Bordeaux). Ann. radiol. 3, R.293-304(1960). (In French)

The question of gonad doses received during treatment by radiotherapy is studied. The study covered two aspects: the measurement of gonad doses and the distribution of treatment by radiotherapy between malignant and nonmalignant conditions. Extrapolations of the results of an investigation made at a regional Centre Hospitalier allows at least a rough estimate to be made of the number of treatments for the whole of France. The results are rather imprecise because of insufficient accurate statistics related to the problem, but they give an order of magnitude which allows the gonad dose resulting from radiotherapy to be estimated at about 20% of the dose arising from the use of ionizing radiations in diagnosis. (auth)

438

DETERMINATION OF DOSE RATES FROM BETA TRANSMISSION CURRENTS. Arthur Bradley (Radiation Research Corp., New York). J. Appl. Phys. 31, 1826(1960) Oct.

In calculations of absorbed dose rates from experimental measurements of β-transmission currents, the relationship can be reduced to a simple function of the β emission and area of the irradiated sample. The beta current extrapolated to zero sample thickness divided by the weight of the sample gave the dose rate. The dose-rate function of

the β-transmission current was found to be nearly independent of the isotope. (M.C.G.)

439

OBSERVATIONS ON THE EFFECTS OF RADIOACTIVITY OF VENTILATING AIR ON HUMAN CONDITIONS. K. Nowak. Neue Physik, No. 3, 65-81(1959). (In German)

There is a relationship between radioactivity of the ventilating air and injuries to health and well-being, at least of a group of susceptible people. It is apparently a case of a particular influence on the vegetative nerve system. The observed phenomena are generally the result of a contact irradiation of sensitive nerves, which can particularly be produced by so-called hot particles, agreeing on the one hand with calculated radiation intensities and on the other hand with known facts on the effective health influence of small radiation doses. In this type of effect it depends first on the intensity and RBE of the radiation, and not especially on chemical nature, which should first, for incorporation in tissue, play a decisive role. (tr-auth)

440

DOSE RATES FROM BACKGROUND GAMMA RADIATION TO POPULATIONS IN FOUR DISTRICTS IN SCOTLAND [SUMMARY]. F. W. Spiers (Univ. of Leeds, Eng.). Proc. Roy. Soc. Med. 53, 763-4(1960) Sept.

Surveys of radiation dose rate were made in two predominantly granite districts and in two districts of sedimentary rocks. Data are tabulated on the mean bone-marrow dose rates. (C.H.)

441

STORAGE FACILITIES FOR RADIOACTIVE MATERIALS: PRACTICAL HOMEMADE UNITS. R. S. Clayton and H. A. DuBose, Jr. Radiology 75, 615-19(1960) Oct.

Designs for practical radioactive materials storage safe and transport cart are described. (auth)

442

RADIOACTIVE FALL-OUT WITH RESPECT TO CHEMISTRY. H. Bergh, G. Finstad, L. Lund, B. Ottar, and T. Wik (Forsvarets Forskningsinstitutt, Lilleström, Norway). Svensk Kem. Tidskr. 71, 678-94(1959). (In Norwegian)

A review of the world-wide radioactive fall-out mechanism and pattern is given. Contemporary theories are discussed in relation to measurements of Sr^{90} and Cs^{137} performed in Norway. (auth)

443

A SUMMARY OF RADIOCHEMICAL ANALYSES MADE ON FALL-OUT SAMPLES GATHERED DURING THE PERIOD 1957-59 AT RISÖ. A. Aarkrog (Atomenergikommissionens Forsögsanslaeg, Risö, Denmark). Svensk Kem. Tidskr. 71, 721-8(1959). (In Danish)

The present paper deals with measurements of the background radioactivity in the Risö area in Denmark during the period 1957 to 1959. The chemical methods for the determination of some of the most common fission products are briefly described, and some of the results of the measurements are mentioned. In 1958 to 1959 there was found an average trebling of the fission product activity in air and grass samples compared to 1957 to 1958. (auth)

444

ENERGY DISCRIMINATING METHOD FOR DETERMINATION OF RADIOACTIVE FALL-OUT. K. Edvarson and K. Löw (Försvarets Forskningsanstalt, Stockholm). Svensk Kem. Tidskr. 71, 729-32(1959). (In Swedish)

A γ-spectrometric method for the determination of individual nuclides in fall-out from nuclear weapons is discussed. Determinations were, as a routine, made of the nuclides $(Zr + Nb)^{95}$, Ru^{103}, Cs^{137}, $(Ba + La)^{140}$, and Ce^{141}. With the apparatus used the lower limit of detection of an individual nuclide is about 100 pc. (auth)

445

CHEMICAL STUDIES PROMOTED BY RADIOACTIVE FALL-OUT. David Dyrssen (Försvarets Forskningsanstalt, Stockholm). Svensk Kem. Tidskr. 71, 733-9 (1959). (In Swedish)

The chemical studies promoted by radioactive fall-out are concerned both with the evaluation of the health hazards from fall-out and the protection against these hazards. The article briefly reviews work in this field that was carried out at the Research Institute of National Defence (FOA) in Stockholm, as well as some problems that are being considered at present. Among these problems are the determination of the chemical and physical properties of fall-out particles and the preparation of simulants for various experiments such as large-scale γ-decontamination and water filtration in the case of nuclear warfare. Another problem is the separation of calcium and strontium for both analytical purposes and the purpose of removing strontium from liquids without removing calcium at the same time. (auth)

446

OCHRONA ZDROWIA PRZED PROMIENIOWANIEM JONIZUJACYM (ATOMOWYM). (Protecting Personnel Against Ionizing Radiation). Ignacy Adamczewski. Warsaw, State Publishing House of Medical Literature, 1959. 207p.

A monograph is given describing the basis of atomic theory; the effect of ionizing radiation on matter; radiation dosages; the influence of ionizing radiation on living organisms; radiation damage; and protection against radiation damage. The monograph is directed primarily toward the medical and biophysical sciences, but is intended also for other scientific and technological workers. It is virtually a condensation of all applied nuclear and reactor physics, including electronics, as applied to organizing and operating a health-physics laboratory. (TTT)

447

QUANTITIES, UNITS AND MEASURING METHODS OF IONIZING RADIATION. A SYMPOSIUM, ROME, APRIL 14-15, 1958. Franco Fossati, ed. Milan, Ulrico Hoepli, 1959. 374p. (In English)

Papers are presented from a symposium of scientists from France, the United Kingdom, Italy, Sweden, Switzerland, the Netherlands, and Germany. The topics adhere closely to the stated subjects of radiation measurement and units. Separate abstracts were prepared for 16 papers. (T.R.H.)

448

THE EXPOSURE DOSE: CONCEPT AND MEASUREMENT. A. Allisy (Ecole Normale Supérieure, Paris). p.25-43 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

The basic radiant energy quantities are defined in terms of watts and joules. This is then extended to an exposure dose concept. Exposure dose is defined as a measure of the ability of radiation of a place to produce ionization. The unit is the roentgen (r) defined as radiation producing 1 esu (electrostatic unit) in 0.001293 g of air. It is proposed that this definition be worded: quantity characteristic of irradiation which expresses its ability to produce ionization in air. The distinction between agent and effect

is made. Measurement of dose is then discussed in this light. It is stated that chambers intended for exposure dose measurement should be regarded as secondary instruments whose design is only valuable because of the calibration by free-air chambers. (T.R.H.)

449

CONCEPT AND MEASUREMENT OF ION DOSE. H. Fränz and W. Hübner (Physikalisch-Technische Bundesanstalt, Brunswick). p.66-79 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

The simplicity and reliability of air ionization methods are pointed out, and a proposal is made for the definition of a generally valid ion dose. The term ion dose distinguishes from energy dose to express measurement of an ion charge. (T.R.H.)

450

THE CONCEPT OF ABSORBED DOSE AND ITS MEASUREMENT. W. J. Oosterkamp (Philips Research Labs., Eindhoven, Netherlands). p.86-99 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

The concept of absorbed dose is discussed to show its complementary qualities with exposure dose. Methods are then given for measuring absorbed dose of any kind of radiation. (T.R.H.)

451

DETERMINATION OF CONSTANTS NEEDED FOR THE CALCULATION OF ABSORBED DOSE FROM IONIZATION MEASUREMENTS. J. W. Boag (Mount Vernon Hospital, Northwood, Middx., Eng.). p.100-17 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

The Bragg-Gray equation relating absorbed energy to cavity ionization is discussed in the light of more recent findings and theories. The improved estimates for W, average energy absorbed per ion pair, are reviewed. Experimental values are given for W_{air} for electrons, W for α particles and electrons in various gases, and the stopping-power ratio $\bar{S}_m$. The density effect on stopping power is discussed, and remarks on the accuracy of absorbed dose measurements are included. (T.R.H.)

452

ABSORBED DOSE ESTIMATION IN THE HUMAN BODY AND THE SPECIFICATION OF DOSE IN RADS. F. Ellis (Oxford Univ.). p.118-35 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

The clinical radiologist needs to correlate biological effect with the radiation dose; hence the term absorbed dose and the rad unit. Estimation of the absorbed dose is presently done using the data of ionization measurements, and applying the Bragg-Gray principle. Difficulties connected with these calculations and disparities in prescribing and recording doses are pointed out and discussed. Results of a poll of clinical radiotherapists are given for questions as to dose differences which can be assessed clinically, and absolute accuracy in measuring x-ray output. The possible errors in clinical dosage are outlined, and an argument for use of the rad is presented. (T.R.H.)

453

THE CONCEPT AND ESTIMATION OF INTEGRAL ABSORBED DOSE. M. V. Mayneord (Royal Cancer Hospital, London). p.138-48 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

The units used for the quantity obtained by integrating dose throughout a given volume are given, and methods of estimation are pointed out. The utility of the concept in clinical practice is discussed. (T.R.H.)

454

HIGH ENERGY RADIATION DOSIMETRY. M. Tubiana and J. Dutriex (Institut G. Roussy, Villejuif, France). p.149-80 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

The units of radiation flux (exposure dose and roentgen) are examined from the theoretical, technical, and practical aspects, and the rad, or absorbed dose unit, is described. The need for an exposure dose for high-energy x rays is mentioned, and it is suggested that rad units for high energies be accompanied by numerical values of parameters used. It was further stated that errors due to heterogeneity of the human body are greater than physical errors, and corrections in these errors should be worked on. It is suggested that x rays for which a standard air-wall chamber becomes impossible (>0.5 Mev) be considered as high-energy x rays. (T.R.H.)

455

DOSIMETRY OF ELECTROMAGNETIC IONIZING RADIATION. A. Drigo (Universith, Ferrara, Italy). p.181-203 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

Some aspects of present-day x- and gamma-ray dosimetry are examined. Chemical dosimetry is useful for mean dose or integral dose, but is not sensitive enough for biology. Reference to ionization of air is convenient. Measurements in an air-wall cavity chamber are reliable only up to 3 Mev. Exposure dose should be expressed in roentgens, absorbed dose in rads. Expressing radiotherapeutic doses in rads involves some difficulties, though. Build-up dose and accuracy of measurement are also considered. (T.R.H.)

456

ON THE DETERMINATION OF THE RADIATION QUALITY. R. Thoraeus (Inst. of Radiophysics, Stockholm). p.211-30 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

The energy spectrum factor in radiation dosimetry is considered. Approaches to the problem are discussed, and the advantages of the half-value layer concept are pointed out. The half-value depth in cm of water is considered a more convenient quantity for soft tissue. (T.R.H.)

457

ERRORS ARISING IN FILM DOSIMETRY AND THEIR ELIMINATION. F. Wachsmann (Universität, Erlangen, Ger.). p.239-50 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

Wavelength dependence, sensitivity factors, and other errors inherent in film dosimetry are discussed. It is concluded that films are suitable for monitoring, especially over long periods. However pocket condensers are better for acute hazards. (T.R.H.)

458

MEASUREMENT PROBLEMS ARISING IN HIGH-ENERGY ELECTRON AND X-RAY THERAPY WITH A 31-Mev BETATRON. R. Widerŏe (Brown-Boveri and Co., Ltd., Baden, Switzerland). p.251-66 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

The use of a 31-Mev betatron for x- and gamma-ray therapy is described, and dosimetry and personnel protection problems are discussed. (T.R.H.)

459

EVALUATION OF LINEAR ENERGY TRANSFER. B. Rajewsky (Max-Planck Institutes für Biophysik, Frankfurt am Main). p.268-87 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

The history of the term "linear energy transfer" (LET) in radiobiology is briefly reviewed, and the use of LET in practice is discussed. Fundamental definitions and practical procedures for evaluation of LET are described. (T.R.H.)

460
SOME FACTORS AFFECTING BIOLOGICAL EFFECTS OF RADIATION. C. Biagini (Università, Rome). p.288-308 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

Some general observations are made on factors affecting the evaluation of relative biological equivalents (RBE). The influence of the trend of recovery processes on evaluation of RBE is discussed. Finally, consideration is given to effects of the size of the irradiated object on RBE. (T.R.H.)

461
RELATIVE BIOLOGICAL EFFECTIVENESS AND THE REM. A. Perussia (Università, Milan). p.309-18 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

Arguments are presented to show that assumption of conventional agreed values of relative biological effectiveness (RBE) is not acceptable theoretically, but is justified by practical needs. The use of the rem is an expedient and may be accepted only if linked to RBE. Both the rem and the RBE should not be extended beyond radiological protection. The rem should be used only in prescribing maximum permissible absorbed doses. (T.R.H.)

462
METHODS OF MEASURING THE EFFECTIVENESS OF PROTECTION AGAINST IONIZING RADIATION. R. Combée and K. Reinsma (Philips X-ray Lab., Eindhoven, Netherlands). p.320-37 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

The International Commission on Radiological Protection (ICRP) recommendations of 1954 are discussed. The characteristic properties of leakage radiation as it affects choice of measuring equipment are summarized. Specific examples of each type of measuring equipment are given. To exemplify the selection procedure outlined, the checking of a diagnostic shield for x-ray protection is described. Finally, lead equivalents of protective materials are discussed. (T.R.H.)

463
GONAD DOSE FROM DIAGNOSTIC PROCEDURES AND ITS GENETIC EFFECTS. J. Lejeune (Humaine de l'Hôpital Trousseau, Paris). p.338-46 of "Quantities, Units and Measuring Methods of Ionizing Radiation." (In English)

Gonad dose and mutation rates are discussed as a radiological hazard. (T.R.H.)

464
METHOD FOR SEPARATING PARTICLES OF RADIOACTIVE MATERIAL FROM A SOLID SURFACE. Ernest Edward Gunn (to United Kingdom Atomic Energy Authority). British Patent 848,588. Sept. 21, 1960.

A simple method for decontaminating a large smooth or irregular surface without extensive rinsing consists of applying a liquid that will form a continuous and flexible film that then can be stripped from the surface. The preferred liquid is a prevulcanized natural rubber latex prepared by heating at 75 to 80°C for 45 min a mixture of natural rubber latex (100 parts by weight) and an aqueous dispersion of vulcanizing agents (0.5 part sulfur, 0.5 part zinc dibutyl dithiocarbamate, and 0.3 part 10% aqueous solution of a surface-active agent). This mixture may be sprayed, brushed, poured, or spread over the surface and allowed to dry for 2 to 3 hr before stripping. It is possible to recover the contaminant from the stripped film by digestion in HNO_3 or some other suitable solvent followed by chemical extraction. Stainless steel, painted steel, and glass surfaces contaminated with radioactive uranium powder were cleaned in the above manner; no radioactivity remained after one application. A rough bitumen-lined sump covered with dust and rain pools was contaminated with dried-out radioactive liquid; one application by spraying gave 2.6% radioactivity remaining, while brushing gave 8.6%. (D.L.C.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

465 AD-232883
American Can Co., Barrington, Ill.
COMPARATIVE RESISTANCE OF SELECTED STRAINS OF CLOSTRIDIUM BOTULINUM IN SELECTED FOOD PRODUCTS. Report No. 5 (Progress) [for] March 15, 1959–May 14, 1959. E. Wheaton and G. B. Pratt. 4p. Project No. 7-84-01-002. Contract DA-19-129-QM-1191.

Three-fourths of the test pack were examined and the same observations previously reported appear to be valid. Screening tests on a spoilage anaerobe isolated from beef were made. (auth)

466 AD-235238
Minnesota. Univ., Austin. Hormel Inst.
INVESTIGATION OF THE IDENTITY AND IMPORTANCE OF THE VOLATILE COMPOUNDS PRODUCED DURING IRRADIATION OF FATS. Report No. 8 (Final) [for] Period: December 27, 1956–October 26, 1958. W. O. Lundberg. 34p. Project No. 7-84-01-002. Contract DA-19-129-QM-834.

The volatile compounds present in irradiated hexadecane, octadecene, methyl oleate, methyl oleate–casein mixtures, and ground beef were studied. Methods for the separation, fractionation isolation, and identification of these compounds were developed. Irradiation of hexadecane, octadecene, and methyl oleate in an atmosphere of oxygen produced mainly peroxides, acids, aldehydes, and typical pungent, rancid, oxidized odors. Unsaturation of the molecule or carboxylic groups is not required for the formation of undesirable compounds during irradiation of lipides. Similar compounds were found in irradiated methyl oleate–casein mixtures, but the odor of these irradiated mixtures was different from that of irradiated methyl oleate alone. The volatile carbonyl compounds from irradiated methyl oleate consisted mainly of saturated and unsaturated monocarbonyls with less than nine carbon atoms and of α-dicarbonyls. A noncarbonyl fraction was tentatively identified as the methyl ester of a terminally epoxidized acid with 8 to 12 carbon atoms. Irradiation of ground beef increases the carbonyl content of the fat. The steam distillates of irradiated ground beef contain considerably more C_8 and C_9 monocarbonyls than the nonirradiated controls. The steam distillates also contained dicarbonyl compounds, some of which are very similar to diacetyl. The extracted fat from ground beef contained monocarbonyl compounds but no dicarbonyls. (auth)

467 AD-235513
National Canners Assn. [Washington Research Labs.], Washington, D. C.
STUDY OF THE DESTRUCTION OF FOOD POISONING ORGANISMS IN CANNED FOODS SUBJECTED TO IONIZING RADIATIONS. Report No. 20 (Progress) [for] June 10,

1959–September 9, 1959. C. W. Bohrer. 3p. Project No. 7-84-01-002. Contract DA-19-129-QM-445.

The inoculated pack studies using Clostridium botulinum in five food products to determine radiation sterilizing doses are continuing. Incubation results did not change. All five products were tested for toxin production in flat cans with negative results. Counts after 1 year of incubation on the three remaining products irradiated at room temperature were made. Toxicity tests on the positive count tubes will be made before these counts will be reported. (auth)

468 AD-235530

Oregon State Coll., Corvallis and Oregon. Agricultural Experiment Station, Corvallis.

INCREASING THE ACCEPTANCE OF IRRADIATED MEAT AND MEAT PRODUCTS BY SELECTED TREATMENTS BEFORE, DURING AND FOLLOWING IRRADIATION. Report No. 12 (Progress) [for] April 27, 1959–July 26, 1959. H. W. Schultz. 43p. Project No. 7-84-01-002. Contract DA-19-129-QM-836.

Changes in gross nitrogenous constituents and amino acids in beef and pork subjected to different pre-radiation temperatures and subsequently stored were correlated with change in irradiation flavor, bitterness, and over-all desirability. Release of nitrogenous constituents is dependent upon pre-irradiation heating, storage time, and storage temperature. It appears that at least 160°F is required prior to radiation. (auth)

469 AD-235583

Utah State Univ., Logan.

STUDIES ON RADIATION PRESERVATION OF FRUIT AND VEGETABLE PRODUCTS. Report No. 1 (Progress) [for] December 1, 1958–February 28, 1959. D. K. Salunkhe. 16p. Project No. 7-84-01-002. Contract DA-19-129-QM-1345.

Progress is reported on the effects of radiation dose and temperature on the preference, microbiological, shelf life, and physio-chemical changes in fruits and vegetables. (auth)

470 AD-235584

Michigan State Univ., East Lansing.

DIP COAT PACKAGING OF IRRADIATED FOODS. Report No. 8 (Progress) [for] Period: July 15, 1959–September 14, 1959. L. J. Bratzler. 4p. Project No. O.I. 6169. Contract DA19-129-QM-1195.

Progress is reported on 6- and 9-month 0°F storage of roast chicken and roast pork coated with three plastic materials. No appreciable change was found in TBA values but panel scores were lower at the end of the 9-month storage than at the end of the 6-month period. (auth)

471 AD-235586

Minnesota. Univ., Austin. Hormel Inst.

STUDY OF FACTORS INFLUENCING OXIDATION WHICH OCCUR IN IRRADIATED FATS. Report No. 1 (Progress) [for] December 31, 1958–June 30, 1959. W. O. Lundberg. 7p. Project No. 7-84-01-002. Contract DA-19-129-QM-1350.

Samples of methyl myristate containing several common antioxidants were irradiated under vacuum or oxygen with up to 8 million rads of gamma rays. The destruction of the antioxidants during irradiation and during subsequent storage at room temperature and at 2 and –20°C was studied by chemical means. Irradiation under vacuum destroyed an appreciable portion of the antioxidants, and the amount of destruction increased with the irradiation dose. In the presence of oxygen, the antioxidants, were more easily destroyed during irradiation, and the effect of dose was not consistent. Destruction of antioxidants during postirradiation storage was negligible compared to the loss of antioxidant resulting from irradiation. (auth)

472 AD-235595

National Canners Assn. [Washington Research Labs.], Washington, D. C.

STUDY OF THE DESTRUCTION OF FOOD POISONING ORGANISMS IN CANNED FOODS SUBJECTED TO IONIZING RADIATIONS. Report No. 19 (Progress) [for] March 9, 1959–June 10, 1959. C. W. Bohrer. 5p. Project No. 7-84-01-002. Contract DA-19-129-QM-445.

The inoculated pack studies using Clostridium botulinum in five food products to determine radiation sterilizing doses are continuing. Incubation results have not changed. Two additional products were tested for toxin production in flat cans with negative results. A new table of D values from survivor curves is included. Counts after 1 year of incubation on the three remaining products irradiated at room temperature are to be made. Toxin tests on the flat cans of beef also will be made. (auth)

473 AD-235598

Michigan State Univ., East Lansing.

INVESTIGATION OF PHYSIOLOGICAL FACTORS WHICH CONTRIBUTE TO THE RADIORESISTANCE OF SPORES OF CLOSTRIDIUM BOTULINUM. Report No. 6 (Progress) [for] March 9, 1959–May 8, 1959. Ralph N. Costilow. 5p. Project No. 7-84-01-002. Contract DA19-129-qm-1177.

Progress is reported on the testing of different media and techniques for recovery of unirradiated and irradiated spores. The influence of two levels of sodium thioglycollate in broth recovery media was tested. (auth)

474 AD-235601

Continental Can Co., Inc., Chicago.

COMPARATIVE RESISTANCE OF STRAINS OF CLOSTRIDIUM BOTULINUM TO IONIZING RADIATION. Report No. 5 (Progress) [for] Period: June 11, 1959 to September 10, 1959. J. M. Heinen. 5p. Project No. 7-84-01-002. Contract DA19-129-qm-1214.

Spore suspensions of five strains of Type A, six strains of Type B, and three strains of Type E Cl. botulinum were prepared and standardized. Inocula of 100 million spores per can (202 × 202) of a beef stew substrate were exposed to various levels of gamma irradiation to produce partial spoilage. From the partial spoilage data radiation D values (dose for 90 per cent destruction) are calculated as a measure of radiation resistance. (auth)

475 AD-235603

Purdue Univ., Lafayette, Ind.

DEVELOPMENT OF IRRADIATION STERILIZED MEAT PRODUCTS. Report No. 2 (Progress) [for] April 16, 1959–July 16, 1959. W. J. Stadelman. 10p. Project No. 7-84-01-002. Contract DA-19-129-QM-1364.

Progress is reported on the effects of microwave heat application prior to irradiation and hormonization during the growing period on flavor, odor, appearance, and tenderness of poultry meat treated with up to 5×10^6 rads of γ radiation at 0 days storage. (auth)

476 AD-235609

Oregon State Coll., Corvallis and Oregon. Agricultural Experiment Station, Corvallis.

STUDY AND INVESTIGATION OF RADIATION RESISTANT ORGANISMS IN FOOD. Report No. 9 (Progress) [for] May 1, 1959–August 31, 1959. A. W. Anderson. 13p. Project No. 7-84-91-002. Contract DA-19-129-QM-1055.

Salt (NaCl) at the 2 and 3% level in ground round appears to lower the level of radiation required to inactivate Clostridium botulinum. The effects were observed with 3%

salt at 1.5 megarad and with 2 and 3% salt at 2 megarad. Irradiation experiments with spice additives have not been completed to the point where any conclusions can be drawn. However, it appears that some spices do increase the radiation resistance of Clostridium botulinum, with toxin production not always demonstrable. Levels of heat sufficient to inactivate most enzymes (i.e., 180°F and less) and simultaneous radiation up to and including 2 megarad resulted in rapid spoilage of the test sample with toxin production easily demonstrated. (auth)

477 BRL-Memo-1242

Ballistic Research Labs., Aberdeen Proving Ground, Md.

THE APPLICATION OF RADIOACTIVE TRACES TO SHAPED CHARGE LINERS. M. K. Gainer. Jan. 1960. 24p. DA Project No. 5B03-04-009.

Radioactive tracers were used to study the contribution of different segments of a shaped charge liner to the penetration of steel targets by the jet for confined and unconfined rounds. It was found that in a confined round, only the base region of the liner contributed significantly to penetration, whereas the base region contributes little to penetration when the round is unconfined. Penetration time measurements showed that the jet velocities at the maximum depth of penetration were the same for both confined and unconfined rounds. These observations indicated that the jet from the upper part of the confined round lacked a high enough velocity gradient to produce penetration, whereas the jet velocity gradient from the same region of an unconfined round was much higher. Consequently, the jet from the base region of the unconfined round reached a velocity that was too low to produce penetration. It was concluded that the effect of confinement is to produce a steady-state collapse over all but the base region of the liner, and that nonsteady-state collapse takes place over nearly the entire liner when unconfined. (auth)

478 NP-8891

Southern Research Inst., Birmingham, Ala.

DETERMINING THE FUNCTIONAL PROPERTIES OF FOOD CONTAINERS USED FOR FOODS IRRADIATED IN COMBINATION WITH MODEL FOOD SYSTEMS. Report No. 10 (Annual) [for] Period September 25, 1956–March 24, 1958. (Report No. 20 (Final) [for] Period September 25, 1956–September 24, 1959). Charles E. Feazel. 138p. Project No. 7-84-01-002. Contract DA-19-129-QM-759.

The object of this investigation on the radiation preservation of foods was to study the interaction between plastic packages and model foods when they were irradiated together. Water solutions of sodium chloride, acetic acid, and sucrose presented relatively few difficulties and could be packaged in Scotchpak and several other combinations of polyethylene. Methionine solution was a little more difficult but was successfully packaged in polyethylene-cellophane. Salad oil and 5% lactic acid solution were the most difficult and could be held only in Scotchpak and a laminate of polyethylene-aluminum-Mylar-polyethylene. Radiation caused fragmentation of polymer molecules so that extractable materials were produced in amounts estimated to be possibly as high as 4% by weight of the film. Odoriferous compounds were also released by irradiation. (auth)

479 NP-8892

DeBell and Richardson, Inc., Hazardville, Conn.

TO INVESTIGATE MATERIALS FOR CONTAINERS FOR PACKAGING FOODS. Report No. 14 (Final) for September 28, 1956–March 31, 1959. Wesley S. Larson. Dec. 15, 1959. 90p. Project No. 7-84-01-002. Contract DA-19-129-QM-764.

Extensive tabulations are given of the effects of 0.5, 1, 2, 3, and 6 megarads of β radiation on foods and food materials sealed in a wide variety of plastic containers. Permeability test and relative humidity test data are also given. (T.R.H.)

480 NP-8931

Hazelton Labs., Falls Church, Va.

LONG-TERM FEEDING AND REPRODUCTION STUDIES ON IRRADIATED CORN AND TUNA FISH. Final Report for September 13, 1957 to September 11, 1959. O. E. Paynter. 135p. Contract DA-49-007-MD-788.

The 2-year feeding of corn and tuna irradiated at 2.79 and 5.58 megarads to male and female albino rats was completed. The gross appearance and behavior of test rats were comparable to those of the controls throughout the study. Respiration, body weight, tumor formation, food consumption, survival, hematology, organ weights, histology, and reproduction all showed no abnormalities. (T.R.H.)

481 NP-9063

Oregon. Agricultural Experiment Station, Corvallis and Oregon State Coll., Corvallis.

THE GROWTH, BREEDING, LONGEVITY AND HISTOPATHOLOGY OF RATS FED IRRADIATED OR CONTROL FOODS (TISSUE ENZYME STUDIES). Semiannual Report No. 1 [for] September 15, 1959–April 1, 1960. Ian J. Tinsley and Edward C. Bubl. 7p. Contract DA-49-007-MD-580, Report No. 5.

Male rats were fed rations containing 70% pork (dry-weight basis) for 4 to 5 weeks, and liver cytochrome oxidase assays were runs. Both control and irradiated pork were used, and these two basic rations were fed either with or without vitamins, making a total of four rations in all. Animals fed the irradiated-pork rations showed increased liver cytochrome oxidase activity. The presence or absence of exogenous vitamins did not have any marked effect on the cytochrome oxidase activity. Vitamin A levels were assayed in female rats raised on rations containing either control or irradiated carrots. There was some indication that the liver vitamin A level was higher in animals fed the control carrot ration; however, the large variation within a group tended to mask any treatment differences. The decrease in the rate of fructose oxidation observed in heart homogenates from rats raised on rations containing irradiated jam was not observed in the fourth-generation animals. (auth)

482 NP-9071

General Mills, Inc. Central Research Labs., Minneapolis.

FUNDAMENTAL STUDIES OF RADIATION SOURCE DOSIMETRY AND THE EFFECTS OF IONIZING RADIATION ON SUGARS. Report No. 7 (Progress) [for] Period April 1, 1959–September 30, 1959. J. S. Andrews. 23p. Project No. 7-84-01-002. Contract QMR&E (Natick) No. 78.

The cellophane-dye dosimeter has been used to measure the distribution of dose in No. 2 and No. 10 cans of Masonite irradiated in a Co^{60} source and the spent fuel rod sources at MTR and Dugway. In order to make a better comparison, the unattenuated dose in the radiation fields was measured by irradiating cans of Styrofoam containing dosimeters placed at positions corresponding to those in the Masonite. The No. 2 can in the Co^{60} source shows a ±9% variation from the mean dose in the can; the No. 10 can shows a ±12% variation. This variation is due, in part, to the specific source design. The No. 10 can at MTR shows a −5 to +15% variation from the center dose. At Dugway, a ±6% variation was obtained. The Co^{60} results agree with the calculated values. The pressure produced by irradiation of a 30% sucrose solution was measured. The pressure at 1 megarad was 0.81 psi and at 5 megarads

9.68 psi. The postirradiation pressures were also measured. (auth)

483 NP-9072

Michigan. Univ., Ann Arbor. Fission Products Lab.
FLAVOR CONTROL OF IRRADIATED BEEF. Report No. 1 (Progress) [for] Period July 1, 1959–September 30, 1959. Lloyd E. Brownell. 9p. Project No. 7-84-01-002. Contract DA-19-129-QM-1419.

The mixture referred to as sample No. 120 mixture was modified to increase its effectiveness in prevention of off-flavors and to produce cooked irradiated beef of greater acceptability. The B-carotene and Vitamin A acetate of the previous mixture have been replaced by Vitamin A palmitate, which produced a more palatable product since the palmitate does not contribute the slight acetic flavor to the irradiated product observed with the acetate. The antioxidant properties of α-tocopherol have been enhanced by the inclusion of a phosphate (monobasic phosphate). The flavor of irradiated beef (cubed steak) treated with the phosphate-tocopherol and stored at 40°F for 2 weeks was better than that which was prepared with No. 120 mixtures. (auth)

484 NP-9168

Syracuse Univ., N. Y. Research Inst. Biological Research Labs.
I. LONG TERM RAT FEEDING EXPERIMENT ON SHRIMP, ORANGES, AND WHOLE ORANGES. II. EFFECTS OF IRRADIATED FOODS ON ENZYME LEVELS OF INTESTINAL TISSUE. Progress Report No. 6 [for] Period: September 15, 1959–March 15, 1960. A. W. Phillips. 10p. Contract DA-49-007-MD-783.

Long-term feeding of irradiated shrimp, peeled oranges, and whole oranges to rats was studied as to histopathological changes and tissue enzymes. A total of 226 rats was used, including 23 offspring. (T.R.H.)

485 NYO-2640

Textile Research Inst., Princeton, N. J.
STUDY OF THE INDUSTRIAL POTENTIAL OF RADIOISOTOPIC METHODS IN THE TEXTILE INDUSTRY. Period covered: April 1959–June 1960. Ludwig Rebenfeld and Howard J. White, Jr. July 25, 1960. 26p. Contract AT(30-1)-2365. OTS.

A critical study is presented of the potential utility of radioisotope techniques in textile technology. Areas where radioisotope techniques might be applied are examined, and the obstacles to the introduction of these techniques are discussed. The major deterrent to greater use of isotopes in the textile field is the cost of equipment containing the isotopes. This is true both for sources for irradiation and for radiation gaging. Another significant deterrent involves the question of health physics. Several areas of radioisotope application are discussed. (auth)

486 TID-6088

Midwest Research Inst., Kansas City, Mo.
STUDY OF THE INDUSTRIAL POTENTIAL OF RADIOISOTOPIC METHODS IN THE SYNTHETIC DETERGENT AND SOAP INDUSTRY. Final Report [for] March 1–November 30, 1959. Charles W. Stanley. Mar. 31, 1960. 56p. Project No. 2276-C. Contract AT(40-1)-2514. OTS.

A review of the potential for radioisotope applications in the soap and synthetic detergent industry is presented. Applications are recommended in research and development, soap and detergent manufacturing process control, and analytical separations and analyses. (J.R.D.)

487 UCRL-6049

California. Univ., Livermore. Lawrence Radiation Lab.
THE VERNI-RAY, AN INSTRUMENT TO MEASURE THE UNIFORMITY OF THIN FOILS. J. Benveniste, R. Booth, A. Mitchell, C. Schrader, and J. Zenger. Aug. 23, 1960. 9p. Contract W-7405-eng-48. OTS.

The VERNI-RAY, an instrument using an alpha source and a solid-state detector in conjunction with a pulse-height analyzer, was designed to yield relatively fast topographical mappings of the surface density of thin foils to an accuracy of 5 μg per square centimeter. A description and data on the operation, and performance of the VERNI-RAY are included. (auth)

488

ALL-UNION CONFERENCE ON APPLICATIONS OF RADIOACTIVE ISOTOPES AND NUCLEAR EMISSIONS IN THE NATIONAL INDUSTRY OF USSR. Atomnaya Energ. 9, 221-43(1960) Sept. (In Russian)

Papers presented at the All-Union Conference on Industrial Applications of Radioactive Isotopes and Nuclear Emissions in the National Economy of USSR, April 12 to 16, 1960, in Riga are surveyed. Short summaries are given on applications of radioactive isotopes and nuclear emissions in prospecting, developing mineral resources, metallurgy, ore enrichment processes, machine construction technology, agriculture, food processing, and medicine. Sources of α, β, and γ radiation for control and automation of processes are also discussed. The full reports from the conference will be published in 1960. (R.V.J.)

489

A RADIOMETRIC METHOD FOR DETERMINING THE FUEL VALUE OF COAL. Sándor Bisztray-Balku (Power Plant Designing Bureau, [Budapest]), András Lévai, János Kakas, Mihály Nagy, and Károly Varga. Energia és Atomtech. 13, 472-8(1960) June. (In Hungarian)

Tests with Tm^{170} show close correlations between the γ absorption (linear absorption coefficient) of various grades of Pecs coal and their specific weight, calorific value, and ash content, indicating that these values can be determined with the aid of radioisotopes. The accuracy of the radiometric method (±0.0489 g/cm^3 for specific weight, ±230 kcal/kg for calorific value, and ±2.8% for ash content) compares favorably with the conventional laboratory tests but fails to meet government testing requirements. The accuracy can be improved. The speed of this method warrants further development, particularly for the automatic control of coal mixing in power plants. (JPRS)

490

THE EFFECT OF HEAT AND IRRADIATION ON THE MICROFLORA OF CANNED HAMS. Suzanne Dewees Drake, James B. Evans, and C. F. Niven, Jr. (American Meat Inst. Foundation, Chicago and Univ. of Chicago). Food Research 25, 270-8(1960).

The bacterial flora of canned hams before heat processing consisted largely of a variety of lactic acid bacteria. Either the normal commercial heat processing or irradiation with approximately 1 megarad of gamma irradiation destroyed most of the flora but permitted survival of spores of bacilli and clostridia and occasionally nonspore-forming lactic acid bacteria. The most troublesome of these latter organisms would appear to be Streptococcus faecium, some strains of which were unusually resistant to both heat and irradiation. The combination of moderate levels of heat and irradiation did not appear to have any particular advantage over present methods of heat processing followed by refrigerated storage. (auth)

491

International Atomic Energy Agency, Vienna.
LARGE RADIATION SOURCES IN INDUSTRY. CONFER-

ENCE PROCEEDINGS, WARSAW, 8-12 SEPTEMBER 1959. VOL. 2. 1960. 452p. $4.50.

The thirty papers included are divided according to the categories: radiation and chemical reactions; special application of radiation; radiation in food preservation; economics of radiation processing; and survey papers. Separate abstracts were prepared for each paper. (B.O.G.)

492

CURRENT CONCEPT AND STATUS OF RADIATION PRESERVATION OF FOODS. R. G. H. Siu (U. S. Army Quartermaster Corps., Washington, D. C.). p.303-17 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." (In English)

Progress made during the last decade on the treatment of goods with ionizing radiations is summarized and evaluated, and a description of the nature of the process itself is given. The current state of the art is discussed, including available and planned sources of ionizing radiation, the effects on organisms, the effects on foods, and the economics of the process. (auth)

493

IRRADIATION PLANT COMPARATIVE OPERATING COSTS OF PLANT USING COBALT-60 OR SPENT NUCLEAR FUEL ELEMENTS. J. R. Puig (Commissariat à l'Énergie Atomique, Paris). p.321-39 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." (In French)

The annual cost of supplying radiant energy to an irradiation facility having a capacity of approximately 0.4 kw of utilizable gamma radiation was determined. Four types of plant are considered. The radiation sources discussed are spent uranium rods or Co^{60} slugs. The spent fuel elements have in one case a burn-up of 400 Mwd/ton after use in a nuclear reactor operating at an approximate mean power of 3 Mw/ton and in the other a burn-up of 3,000 Mwd/ton obtained with a reactor operating at 10 Mw/ton. The 400 Mwd/ton and 3,000 Mwd/ton spent uranium elements are used during the fourth month and between the sixth and eighteenth months, respectively, after their removal from the reactor. The facilities using uranium rods may differ as regards their situation in relation to the place where the rods are stored, which is assumed to be a tank. Cost prices are calculated for each case. It may be concluded that for the present, Co^{60} is more economical than spent uranium elements, but that over the longer term Co^{60} and high-burn-up uranium elements might prove to be mutually competitive. (auth)

494

RADIATION-INDUCED CHLORINATION OF VINYL POLYMERS AND ITS COST EVALUATION. S. Okamura (Kyoto Univ.), K. Hayashi, M. Hirata, and R. Kuroda. p.341-56 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." (In English)

The radiation initiated chlorination of polyvinyl alcohol, polymethyl methacrylate, polymethyl acrylate, polyacrylonitrile, polyvinyl acetate, polystyrene, and polyethylene is studied. The relative amounts of substitution and addition are determined for polystyrene. A tentative mechanism is given for the chlorination reaction. The economics of the radiation-induced chlorination of polystyrene and polyvinyl alcohol are considered and it is concluded that the costs of such a process are relatively cheaper than was hitherto thought. (auth)

495

TECHNOLOGY AND ECONOMICS OF LARGE RADIATION SOURCES. Michael Michaelis (Arthur D. Little, Inc., Cambridge, Mass.). p.363-86 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." (In English)

A study was undertaken to summarize and analyze world technology relevant to industrial applications of high-level penetrating radiation. Derived from that study and presented here is a comprehensive and quantitative account of the present status and foreseeable trends in the technology and economics of radiation sources now in use and under development in the United States. Principal attention is focused on radioisotope sources such as Co^{60} and Cs^{137}, and on electron accelerators such as Van de Graaff, resonant transformer, dynamitron, and linear accelerator. Technological features of these sources are discussed in relation to existing and potential industrial process applications. Cost factors are analyzed and quantitative data are presented on capital, installation, operating, and maintenance costs of various sources. Estimates are presented for the total cost per kw-hr of radiation output as a function of type and size of the source. It is recognized that these "radiation-production cost factors" are only some of the variables in the economic equation of radiation technology. Attention is drawn to some of the "application factors" which must be taken into account in arriving at sound economic judgements. As far as radiation-production costs are concerned, it is concluded that there are good prospects for achieving costs as low as 10 cents per kw-hr of radiation output, whereas present-day costs are in the range of one to ten dollars per kw-hr. In discussing specific prospects for low radiation costs, reference is made to other radiation sources, such as reactors, which show some particular promise in this regard. In order to provide proper perspective, other sources of ionizing radiation are discussed—e.g., spent fuel elements, fission product gases, recoil fission fragments, electric discharges, and ultra-violet light—some of which show usefulness in certain specific areas of industrial process applications. (auth)

496

IRRADIATED POLYETHYLENE: A CASE STUDY IN THE ECONOMICS OF PRODUCTION USE OF ELECTRON BEAM RADIATION. J. W. Ranftl (General Electric Co., Milwaukee). p.387-96 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." (In English)

A production process for the cross-linking of polyethylene by radiation is discussed and the cost is considered for 4,000 hours operation per year. The investment costs considered include: (1) the capital cost of the apparatus, (2) building and shielding costs, and (3) conveyor and auxiliary equipment. The operating costs include: (4) maintenance cost for equipment, (5) labor costs of process attendants, and (6) power costs. In addition, the efficiency of the process is considered and the following factors are included: (7) time efficiency of machine utilization, and (8) absorption efficiency of the product and process. (auth)

497

SURVEY OF RECENT TRENDS IN POLYMER RADIATION WORK. A. Charlesby (Royal Military Coll. of Science, Shrivenham, Wilts, Eng.). p.399-408 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." (In English)

A summary is given of the lines of development in the polymer field. The criteria for the economic production of various materials by radiation are discussed and it is concluded that in the polymer field, the cost of radiation proc-

essing should not be excessive. Radiation-initiated polymerization is considered; it is pointed out that the new techniques of low temperature polymerization and the addition of finely divided surfaces to the polymerization media offer considerable possibilities. The curing of polyester resins and the vulcanization of rubbers are briefly discussed. It is felt that the main emphasis on research should be on systems which are reactive only to radiation. The importance of the investigation of oriented materials is stressed. In conclusion it is felt that much more fundamental research is needed and that a closer understanding of the fundamentals of the subject will lead to new lines of development. (auth)

498
THE UNITED STATES INDUSTRIAL RADIATION PROGRAMME. Paul C. Aebersold (Office of Isotopes Development, AEC). p.409-23 of "Large Radiation Sources in Industry. Conference Proceedings, Warsaw, 8-12 September 1959. Vol. 2." (In English)

Adequate sources of ionizing radiation for commercial scale processing are now available from radioisotopes, nuclear reactors, and several types of machines. Costs of radiation power are beginning to come within ranges attractive to industry. Increased research efforts, however, are necessary to develop processes which merit large-scale economic demonstration. A review is presented of U.S. efforts to discover major industrial radiation applications. Included is a summary description of more than 200 U.S. radiation facilities, exclusive of nuclear reactors. A broad program of basic radiation chemistry research is being performed at government laboratories, universities, and a limited number of private companies. Radiation studies by most U.S. companies are highly applied. The level of effort on industrial radiation process research in the United States is estimated at $10,000,000 annually. (auth)

ISOTOPE SEPARATION

499 A-52
Columbia Univ., New York.
THE INFLUENCE OF BAFFLES ON A COUNTER-CURRENT ULTRA-CENTRIFUGE. Karl Cohen. [1947]. Decl. Sept. 23, 1960. 10p. OTS.

An analysis of fractional distillation processes in a long empty ultracentrifuge suggests that the use of appropriate baffles in the gas stream might improve the separations obtainable. The influence of ring-shaped baffles is discussed quantitatively by familiar theoretical methods. It is concluded that the introduction of baffles of certain dimensions will materially improve the concentration of isotopes in columns of the type discussed. (auth)

500 A-53
Columbia Univ., New York.
MAIN NUMERICAL RESULTS ON THE SEPARATION OF UF_6 BY CENTRIFUGES. Karl Cohen. Mar. 3, 1941. Decl. Sept. 23, 1960. 7p. OTS.

Data are given on the theoretical total length of spinning rotors necessary to produce 1 kg/day of U^{235}-enriched UF_6, contained in a continuous working quantity of 10 kg of U^{235} and U^{238} mixture in UF_6. Other data on two fractionally distilling centrifuges are given in which the minimum ratios of length to internal radius necessary for production of the specified over-all fractionation factors at calculated efficiencies are included. (J.R.D.)

501 A-119
[Virginia. Univ., Charlottesville].
THE EVAPORATIVE CENTRIFUGE METHOD. F. C. Armistead, T. W. Williams, W. C. Johnston, L. B. Snoddy, and J. W. Beams. [1942]. Decl. Sept. 23, 1960. 10p. Contract OEMsr-140. OTS.

Results are presented of tests to determine the efficiency of the evaporative centrifuge method for separation of isotopes. The separation theory is examined, and data are included which indicate that the separation to be expected may be calculated according to the theory. (J.R.D.)

502 A-1778
Virginia. Univ., Charlottesville.
BRIEF REPORT OF TYPE II CENTRIFUGE OPERATION. J. W. Beams. Feb. 28, 1944. Decl. Sept. 23, 1960. 13p. OTS.

Results of type II UF_6 centrifuge operation are presented. Data from this type operation in a single unit are useful in predicting the operation of a number of centrifuges in cascade. (J.R.D.)

503 A-3391
Virginia. Univ., Charlottesville.
THE SEPARATION OF THE ISOTOPES OF URANIUM IN UF_6 BY THE REFLUXING COUNTERFLOW CENTRIFUGE METHOD. J. W. Beams and L. B. Snoddy. July 14, 1943. Decl. Sept. 23, 1960. 44p. Contract OEMSR-398. OTS.

Results of experiments with tubular centrifuges operated to separate the U^{235} isotope in UF_6 are presented. The data are tabulated and a comparison of experimental and theoretical values is included. (J.R.D.)

504 AERE-R-3372
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE RELATIVE ENHANCEMENT FACTOR IN ELECTROMAGNETIC ISOTOPE SEPARATION. J. H. Freeman. June 1960. 34p. BIS.

The relative enhancement coefficient which describes the performance of an electromagnetic isotope separator is defined. This coefficient is then used to calculate the resolution of the isotopic beams, and a method of predicting enhancements and detecting mass-analysis errors is given. A brief review of isotopic contamination causes is presented and use of the calculated beam shape to evaluate the relative importance of the various causes is demonstrated. (auth)

505 ORO-315
Virginia. Univ., Charlottesville. Research Labs. for Engineering Sciences.
THE DEVELOPMENT OF SHORT BOWL ULTRACENTRIFUGES. Final Report. Gernot Zippe. June 15, 1960. 107p. Contract AT(40-1)-2400. (EP-4420-101-60U). OTS.

Experimental investigations of short-bowl gas centrifuges are described. The experiments include lifetime tests of rotors and bearings, auxiliary measurements on molecular pumps and internal gas handling systems using freon, and separation tests using ClF_3. Future prospects and economy considerations with respect to industrial applications are included. It is noted that final evaluation of the process is not possible at present. (J.R.D.)

506 AEC-tr-4264
ON THE SEPARATION POTENTIAL OF THERMALLY DRIVEN COUNTERCURRENT GAS CENTRIFUGES. W. Groth and K. H. Welge. Translated by K. H. Quasebarth from Z. physik. Chem. (Frankfurt)(N.S.) 19, 1-20 (1959). 36p. JCL.

Issued as Univ. of Virginia Report No. EP-4422-114-60U.

The theory of thermally driven countercurrent gas centrifuges is discussed, and the improvements in the

construction of the centrifuge model ZG3 which were applied in experiments for the enrichment of isotopes of argon and xenon are described. Static enrichment factors and the dependence of the enrichment of the throughput at various pressures, of the peripheral velocity, and of the mean temperature of the rotor are reported as experimental results. From these the separation potential of the gas centrifuge can be calculated. A comparison with the maximum theoretical separation potentials shows that the countercurrent flow profile which is determined by the mass dependent pressure gradient strongly influences the experimentally attainable separation capacity of gas centrifuges. (auth)

507 CEA-tr-X-201

ETUDE D'L'ÉCHANGE HYDROGENE–DEUTERIUM EN PHASE HÉTÉROGÈNE SUR LES ÉCHANGEURS D'IONS. LES ÉCHANGEURS D'IONS. LES ÉCHANGEURS CATIONS I. (Study of Hydrogen–Deuterium Exchange in a Heterogeneous Phase on Ion Exchangers. Cation Exchangers I.). P[iroska] Fodor. Translated into French from Magyar Tudományos Akad. Központi Fiz. Kutató Intézetének Közleményei 6, 71-97(1958). 28p.

A study was made of H–D exchange on Amberlite IR-120 and IRC-50 cation exchange resins in a solution of D_2O as a function of cation exchanger group, temperature, and pH. The exchange increases above 20°C with IR-120; but for IRC-50 it increases to 75°C, then diminishes. On IR-120 the exchange increases as pH diminishes; on IRC-50 the reverse is true. In the case of the carboxylic resin the separation coefficient was <1 because of hydrogen bridges formed between carboxyl groups and the resin and adherent water. The sulfonic acid resin separation coefficient was >1 because of the formation of complex ions. Other findings are described and discussed. (T.R.H.)

508

THE SEPARATION OF HYDROGEN ISOTOPES BY DISTILLATION OF AZEOTROPIC ACID–WATER MIXTURES. K. Wetzel, H. Schütze, G. Kretzschmann, and K. Mühle (Institut für Physikalische Stofftrennung, Leipzig). Naturwissenschaften 47, 374(1960). (In German)

The distribution of hydrogen isotopes between azeotropic mixtures of strong acids with water and the vapor existing in equilibrium with the mixture is definable with chemical exchange equilibria. An expression for the total separation factor $\alpha = (D/H)_{vap}/(D/H)_{liq}$ is given and evaluated for strong monobasic acids. If such a mixture is subjected to counter-current distillation, deuterium enrichment occurs at the head of the column. For the azeotropic mixture HNO_3/H_2O $\alpha = 1.059$ at 121°C. It would be expected that at reduced pressures the separation factor would attain higher values. (J.S.R.)

509

SPEKTROMETRIA MASOWA. (Mass Spectrometry). Włodzimierz Żuk. Warsaw, State Publishing House of Scientific Literature, 1956. 563p.

Chapters are included on methods of mass analysis, mass spectrographs, and mass spectrometers; high-vacuum techniques and vacuum apparatus for mass spectrometry; fundamentals of electron and ion optics; ionization phenomena on metallic surfaces and in gases; ionization and conduction in gases; mass spectrometer ion sources; analysis of ion trajectories; measurement of ion currents; electrical circuits (electronics) for mass spectrometers; construction of mass spectrometers; new methods in mass spectrometry; and applications of mass spectrometry. (TTT)

MATHEMATICS AND COMPUTERS

510 KAPL-2068

Knolls Atomic Power Lab., Schenectady, N. Y.

ALMOST LINEARLY OPTIMUM COMBINATION OF UNBIASED ESTIMATES. M. Halperin. Jan. 6, 1960. 12p. Contract W-31-109-Eng-52. OTS.

A method of combination of estimates is proposed for the case in which each estimate is a simple arithmetic average and the populations sampled are presumed to be Gaussian. This method is almost linearly optimum in the sense that the standard deviation of the combined estimates is identical to that of the minimum variance linear unbiased estimate when variances (and covariances, if any) are known except for a multiplicative factor which approaches unity as minimum sample size becomes large. The results hold whether the samples are correlated or independent, but in the latter case require random matching and data transformation. (auth)

511 NP-9258

Space Technology Labs., Inc., Los Angeles.

TABLES OF UPPER CONFIDENCE LIMITS ON FAILURE PROBABILITY OF 1, 2 AND 3 COMPONENT SERIAL SYSTEMS. VOLUMES I AND II. July 1959. 3½ in. thick. (TR-59-0000-00756).

512 ORNL-2958

Oak Ridge National Lab., Tenn.

CRUNCH—AN IBM-704 CODE FOR CALCULATING N SUCCESSIVE FIRST-ORDER REACTIONS. M. P. Lietzke and H. C. Claiborne. Nov. 7, 1960. 49p. Contract W-7405-eng-26. OTS.

An IBM–704 code, CRUNCH, was written to solve the set of equations arising from N successive first-order reactions; the code can also be used as a subroutine in complex calculations. This code may be easily adapted to the IBM-7090. A simple recursion relationship that represents the solution to the well-known "Bateman equations" is used in the program. The case of repeated roots (equal removal cross sections) can also be handled with the same equation by changing the equal cross sections so that they have values which are different by a small amount. To overcome the loss of significance which may occur when differences in removal cross sections are very small, when neutron exposure times are very short, or when a large number of reactions are considered, the code was written using double-precision arithmetic. The output from the calculation for any specified time and flux gives the amount of each member of the chain, the average microscopic cross section, and the power generation from any fissile material present. (auth)

513 YAEC-104(Suppl.)

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

THE DARED CODE; MODIFICATION OF THE DEADTIME CORRECTION AND AUTOMATIC REPETITION OF COUNTING TIMES. J. Jedruch. Aug. 3, 1960. 6p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. OTS.

In the course of the application of DARED-1 (an IBM–704 program for reducing data from foil irradiation and fitting by least squares to Bessel J_0 or cosine function) it was observed that the performance and convenience of use of the code may be improved by a few minor modifications. The modifications, which consist of an improved treatment of the deadtime correction and an addition of the option of reproducing counting times of one counter for other counters, are described. (W.D.M.)

514 UCRL-Trans-550(L)
SOLUTION OF CAUCHY PROBLEM FOR NON-LINEAR EQUATION WITH DISCONTINUOUS INITIAL DATA BY A METHOD OF FINITE DIFFERENCES. N. D. Vvedenskaya. Translated from Doklady Akad. Nauk S.S.S.R. 111, 517-20 (1956). 11p. JCL or LC.

The Cauchy problem is examined for the non-linear equation $\partial u/\partial t + \partial \varphi(t, x, u)/dx = 0$ ($\varphi''_{uu} = 0$) with the initial condition $u(0,x) = u_0(x)$. It is shown that a generalized solution of u(t,x) can be obtained by the method of finite differences. (W.D.M.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

515 AFOSR-TN-60-707
California. Univ., Berkeley. Materials Research Lab.
INVESTIGATION OF FACTORS CONTROLLING PROPERTIES OF PRESSURE-SINTERED ALKALI HALIDES. Technical Report No. 2. P. J. Fetta and E. R. Parker. June 1960. 24p. Project No. 4759. Contract AF49(638)-601.

A method is described for producing fine-grained polycrystalline alkali halides by a vacuum-pressure sintering technique. A preliminary investigation indicates that in these materials the sintering pressure is related to the lattice energy, the densities approach theoretical values, and the hardness due to the powder's surface contamination is overcome by forming at a pressure higher than that normally used to produce transparency. (auth)

516 AFOSR-TR-60-81
Franklin Inst. Labs. for Research and Development, Philadelphia.
PURIFICATION AND SUBSTRUCTURE FORMATION OF METALS AND PROPERTIES OF HIGH PURITY METALS. Final Report [for] October 1, 1955 to March 31, 1960. Marvin Herman. 10p. Contract AF18(600)-1581. (F-A1878).

The purification of high-melting-point reactive metals by the floating-zone technique was studied. The physical properties of iron, titanium, and zirconium purified by this technique were studied with emphasis on their mechanical behavior. Various types of apparatus and techniques used for floating-zone melting were evaluated. Techniques for observing substructures in zinc single crystals and the mechanism or mechanisms which produce them were investigated. A possible analysis of the nature of substructure in crystals in terms of dislocation models is discussed. (C.J.G.)

517 BM-IC-7928
Bureau of Mines.
BIBLIOGRAPHY OF HAFNIUM. Eleanor Abshire and Sarah Notestine. 1960. 34p. GPO.

A bibliography of references on hafnium is presented. Reference sources reviewed for this compilation include Chemical Abstracts, Industrial Arts Index, Crerar Metals Abstracts, Nuclear Science Abstracts, and Bureau of Mines Information Circulars 7771 and 7830. 670 references. (J.R.D.)

518 CEND-99
Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.
THE DEVELOPMENT AND TESTING OF THE UO_2 FUEL ELEMENT SYSTEM. Quarterly Report for June 1, 1960–August 31, 1960. 47p. Contract AT(30-1)-2379. (NYO-9009). OTS.

Vibratory Compaction. The vibratory-compaction apparatus was modified by the addition of a second high-impact vibrator and vibration-metering equipment. Densities in excess of 90% of theoretical are attainable on a reproducible basis. Some specimens with densities above 91% of theoretical were produced, but tube-wall yielding and bending were sometimes observed at these densities. Some specimens were swaged as a secondary operation to improve the final fuel-rod density. Reductions from 2 to 8% were made. Rock-Rite Elements. A process was developed for producing UO_2 fuel rods by the Rock-Rite tube-reducing process. A final series of 39 rods was produced in order to gather data for a cost analysis and a dimensional-control survey. A cost analysis was performed showing the estimated production costs of 1000 4-ft-long and 1000 8-ft-long fuel rods. Progressive Layer Assembly. Several clusters were produced as a final step in the demonstration of feasibility of the progressive-layer welding concept. Both triangular and square lattices were produced. New welding dies were fabricated with the object of producing welds with tightly controlled weld penetration and setdown plus reproducible dimensional control. Initial results with the new dies indicate some progress. Reduction of Cladding Thickness. Test objectives and procedures were developed to extend the scope and breadth of the previous reported experiments. Performance Characteristics of UO_2 Fuel Elements. A study was initiated to find the maximum sintering temperature of fused UO_2. (auth)

519 DMIC-Memo-65
Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.
COMPATIBILITY OF ROCKET PROPELLANTS WITH MATERIALS OF CONSTRUCTION. W. K. Boyd and E. L. White. Sept. 15, 1960. 66p. OTS.

The compatibility of fluorine, oxygen, ammonia, nitric acid, hydrogen, and hydrogen peroxide with materials of construction, metals, alloys, and polymers is reported in tabular form. (W.L.H.)

520 LAMS-2441
Los Alamos Scientific Lab., N. Mex.
LARGE SCALE PREPARATION OF HIGH PURITY PLUTONIUM METAL BY ELECTROREFINING. Preliminary Report. L. J. Mullins, J. A. Leary, and C. W. Bjorklund. June 27, 1960. 16p. Contract W-7405-ENG-36. OTS.

Plutonium metal produced by the bomb reduction method was successfully refined by electrolysis on the 100 to 300 g scale. The purified product was collected continuously from the cathode as a liquid metal of greater than 99.98% purity. A Pu–10 at. % Fe alloy also was refined by electrolysis to produce a product containing less than 0.02 wt. % iron. A tungsten cathode was shown to be superior to tantalum. (auth)

521 LMSD-288190(Suppl. 2)
Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.
BERYLLIUM—SURVEY OF THE LITERATURE. K. D. Carroll, comp. Aug. 1960. 85p. OTS.

A bibliography containing 228 references is presented on the fabrication, properties, and production of beryllium, beryllium alloys, and beryllium compounds. (C.J.G.)

522 NMI-1216
Nuclear Metals, Inc., Concord, Mass.
TECHNICAL PROGRESS REPORT TO THE AEC REACTOR

DIVISION FOR THE PERIOD ENDING JUNE 30, 1959. July 21, 1960. 156p. Contract AT(30-1)-1565. OTS.

Research and development projects on the cold working of uranium, high-temperature moderator and fuels, production of UC, glass-lubricated extrusion process, and casting of thorium and uranium alloys are reported. Separate abstracts were prepared for each of the major sections of the report. Abstracts of recent topical reports are included. (W.D.M.)

523 NMI-1216(p.49-55)

Nuclear Metals, Inc., Concord, Mass.

HIGH-TEMPERATURE MODERATOR AND FUELS. J. Paul Pemsler.

Various methods of fabricating sound metallic specimens of UBe_{13} and $ZrBe_{13}$ are explored, and the steam corrosion resistance testing of these intermetallics is discussed. (W.D.M.)

524 NP-9240

Oregon Metallurgical Corp., Albany.

DEVELOP PROCESS FOR AND ARC CAST 25 TO 50 POUND INGOTS OF TIN REDUCED MOLYBDENUM. Progress Report for the Period July 31, 1960–August 31, 1960. Allen D. Abraham. 4p. Contract NOrd-18124.

The molybdenum powder produced contained about 0.1% silicon because of transfer of silicious material from the brick in the furnace. (See also AD-230075.) (C.J.G.)

525 NP-9288

General Electric Co. Flight Propulsion Lab. Dept., Cincinnati.

THE EFFECT OF ARC PLASMA DEPOSITION ON THE STABILITY OF NON-METALLIC MATERIALS. Bi-Monthly Report No. 3 Covering Period July–August 1960. B. E. Kramer and M. A. Levinstein. Oct. 3, 1960. 11p. Contract NOas 60-6076-C. (DM-60-231)

High-melting-point carbides, oxides, nitrides, and borides were flame sprayed with a plasma jet spray gun. Chemical and crystallographic analyses were made to determine the stability of the materials. The spraying was done within a controlled environment. (For preceding period see NP-8973.) (auth)

526 NUMEC-P-30

Nuclear Materials and Equipment Corp., Apollo, Penna.

DEVELOPMENT OF PLUTONIUM BEARING FUEL MATERIALS. Progress Report for Period April 1 through June 30, 1960. July 18, 1960. 36p. Contract AT(30-1)-2389. OTS.

Major effort was directed toward assembly of glove boxes and installation and checking out of equipment. Fourteen glove boxes have been installed and connected to the ventilation system. Preparatory to working with plutonium, significant studies were carried out on the preparation and characterization of UO_2. Testing of the ventilation system demonstrated a need for further work on the plant absolute-filter housing to achieve absolute tightness. Details were worked out for "closing" the glove boxes after installation of equipment. The acceptance criterion of 0.01%/hr pressure loss at a box vacuum of 2 in. of water is easily achieved. Fabrication and evaluation of fuel shapes, fuel reprocessing, and reactor physics and engineering parametric studies are discussed briefly. (W.D.M.)

527 NYO-1111

Brush Beryllium Co., Cleveland.

THE PRODUCTION OF HIGH-PURITY BERYLLIUM CARBIDE. J. G. Theodore, W. W. Beaver, A. Dolance, and A. J. Stonehouse. Oct. 15, 1952. Decl. Sept. 21, 1960. 20p. Contract AT(30-1)-541. OTS.

A process for production of pure Be_2C by using the reaction between beryllium and graphite powders at about 1000°C is described. The effects of variables such as stoichiometry, reaction temperature, beryllium-powder particle size, and process-apparatus construction materials are discussed. (J.R.D.)

528 NYO-2688

Olin Mathieson Chemical Corp. Metallurgical Labs., New Haven.

THE DEVELOPMENT OF URANIUM CARBIDE AS A NUCLEAR FUEL. Annual Report No. 1 [for] May 1, 1959 to April 30, 1960. H. S. Kalish, F. B. Litton, F. E. Bowman, J. Crane, and W. C. Hahn. June 13, 1960. 41p. Contract AT(30-1)-2374. OTS.

Powder metallurgical and arc melting and casting methods were studied for making UC shapes. The powder consolidation method involved the investigation of the reaction of methane with uranium. The product from the methane reaction was pyrophoric and extremely reactive with water, oxygen, and nitrogen. In processing, it must be handled either in vacuum or inert gas relatively free from these contaminants. Bulk uranium and graphite was melted together for preparing as skull in the ladle of a skull furnace. A method was devised for making consumable uranium carbide electrodes for arc melting. Owing to poor thermal shock resistance of the carbide, the consumable electrodes were inoperable and disintegrated on arcing at the tip. (W.L.H.)

529 NYO-2689

Olin Mathieson Chemical Corp. Metallurgical Labs., New Haven.

NUCLEAR FUEL RESEARCH, FUEL CYCLE DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT [FOR] APRIL 1 TO JUNE 30, 1960. Herbert S. Kalish and Robert B. Holden. July 27, 1960. 26p. Contract AT(30-1)-2374. OTS.

Work was continued on a UO_2 pellet fabrication process based on inert atmosphere sintering at 1250 to 1300°C. The development of a two-stage sintering method, consisting of a nitrogen soak to densify the nonstoichiometric oxide followed by a hydrogen soak to remove excess oxygen, was initiated. With Davison ADU oxide Lot O, uniform stoichiometric pellets were obtained having a density of 98% of theoretical after 3 hr in nitrogen and 1 hr in hydrogen at 1250°C. Further progress on this sintering technique, however, was hampered by the fact that the other ADU oxide lots employed in the investigation exhibited relatively poor sinterability. Among these was a small batch ordered for a pilot run prior to the procurement of enriched oxide which was to be prepared under similar conditions for the irradiation testing program. A study of the physical and chemical characteristics of the ADU oxide lots on hand was then begun with the objective of establishing a specification based on the correlation of low-temperature sinterability in nitrogen with pertinent properties. With the aim of producing reactive UO_2 sinterable to high densities, small quantities of nonstoichiometric ADU oxide were prepared. Compacts fabricated from this material were sintered at 1300°C to densities as high as 10.3 gm/cc by the two-stage method. A cost study was prepared comparing the low-temperature nitrogen sintering process with a conventional high-temperature hydrogen sintering process. Based on producing UO_2 pellets of the size used in the Yankee Reactor, the low-temperature nitrogen sintering process is estimated to permit cost savings of $0.025 per pellet. Uranium monocarbide was made in a vertical retort in the following manner. Cleaned and pickled bulk uranium was reacted at 3 psig pressure with deoxidized and dried hydrogen at 250°C in a closed

system. The retort temperature was then increased to between 750 and 800°C and the uranium powder carburized in a purified hydrogen-methane mixture. Variables affecting the carbon content were reaction time and temperature and the amount of carburizing gas that flowed through the retort. The carbide powders were processed under argon to avoid contamination and burning in air. After compressing at 35 tons per sq in. pressure and vacuum sintering for ½ hr at 1700°C, the densities varied from 11.30 to 11.71 g/cm³. Further work is in progress to determine the effect of sintering temperatures between 1700°C and the melting point; the addition of uranium, uranium nitride, and uranium oxide; and the addition of selected binding elements, such as niobium and zirconium, on the sintered density of stoichiometric methane produced carbide. The skull furnace was operated systematically to the capacity of the rectifiers to determine design weaknesses and the limitation of the furnace. The preferred charge material was preformed uranium carbide made either by melting uranium with graphite in a button furnace or by reacting uranium powder with graphite in the solid state to form a pellet. It was found that mold preheat minimized surface imperfections. Castings ⅝ in. in diameter by 6 in. long were made in the skull furnace. (For preceding period see NYO-2687.) (W.D.M.)

530 ORNL-2988
Oak Ridge National Lab., Tenn.
METALLURGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 1, 1960. Sept. 30, 1960. 503p. Contract W-7405-eng-26. OTS.

Progress is reported on fundamental metallurgy, long-range applied metallurgy, and reactor metallurgy. Separate abstracts were prepared for each section. (W.L.H.) (W.L.H.)

531 ORNL-2988(p.3-5)
Oak Ridge National Lab., Tenn.
CRYSTAL PHYSICS. G. W. Clark, O. C. Kopp, et al.

Facilities were completed for single-crystal-growth studies using the flame-fusion method and the hydrothermal-autoclave technique. Investigations are in progress for crystal growth of some oxides by hydrolysis of fused-halide melts. An arc-image system and a constricted-arc furnace are being assembled. As a part of an exploratory investigation of mineral synthesis by hydrothermal techniques, the rare mineral kalsilite was synthesized from muscovite mica. Similar experiments designed to grow macroscopic crystals of MgO are in progress. Small crystals of MgO and ZrO_2 were grown by hydrolysis of $MgCl_2$ melts and ZrF_4-LiF-NaF melts, and this work is continuing. Crystal boules of NiO and Al_2O_3 are being grown in the flame-fusion apparatus to evaluate its performance. Later other crystal materials will be tried.

532 ORNL-2988(p.149-52)
Oak Ridge National Lab., Tenn.
PHYSICAL PROPERTIES. D. L. McElroy and T. G. Kollie.

A program to study (1) the mechanisms of heat transport in nonmetallic materials of interest for reactor fuels, moderators, or cladding and (2) the variation of thermal conductivity with such variables as composition, defect structure, grain size, and irradiation was started. A Powell ball apparatus and the equipment for a quenching technique were designed and are being built. Supporting studies to provide UO_2 in varying known conditions were started. These studies include a determination of the Debye temperature, phase composition as a function of heat treatment and chemical composition, and grain growth. (auth)

533 ORNL-2988(p.153-4)
Oak Ridge National Lab., Tenn.
SINTERING STUDIES. C. S. Morgan.

An investigation of the factors influencing the sintering of oxides having the CaF_2 structure was initiated. The influence of surface properties of the oxides, particle size and shape, and substructure are being studied. Work was started on evaluating the sintering characteristics of ThO_2 prepared by a number of different methods. Oxides showing differences in sintering behavior will be further studied in order that the controlling factors might become clear. (auth)

534 ORNL-2988(p.155-66)
Oak Ridge National Lab., Tenn.
SOLID REACTION STUDIES. T. S. Lundy, J. I. Federer, and J. F. Murdock.

A laboratory to be used in connection with the investigation of various solid-state-diffusion phenomena was designed and set up. Cursory experiments were performed for the purpose of technique evaluation. A long-range program was initiated to study the diffusion of solid fission products in reactor fuel and cladding materials. The self-diffusion characteristics of aluminum will also be determined. The ORR fuel-irradiation program was terminated after completion of a gamma-heating experiment. Participation in the ORNL Fast Breeder Assistance Program was carried to completion by the design and fabrication of capsules for irradiation of UO_2–stainless-steel specimens. Evaluation of previous experiments on the UO_2–Al reaction was made. Planned experimental work will be directed at learning the role of gases in the reaction. (auth)

535 ORNL-2988(p.185-96)
Oak Ridge National Lab., Tenn.
CERAMICS LABORATORY. L. M. Doney, A. J. Taylor, et al.

A method was developed for preparing highly sinterable UO_2 powder of reproducible forming and sintering characteristics from UF_6 by the ammonium diuranate process. A recycle process for converting UO_2 fabrication scrap to UO_2 powder, which involved precipitation of ammonium diuranate from nitrate solutions, produced powder which in some cases was identical in forming and sintering characteristics to that prepared from UF_6, although O/U ratios were abnormally high. Kinetic studies on the formation of UC and UC_2 from UO_2 and graphite showed that at 1200°C in vacuum the reaction followed a parabolic rate law and that at 1450°C it was essentially complete in 1 hr. The UC_2/UC ratio increased with increasing temperature. The reaction rate increased with decreasing particle size at temperatures below about 1350°C but was relatively insensitive to particle size at higher temperatures. Attempts to prepare uniform, equiaxed orthorhombic bipyramidal crystals of $UO_3 \cdot H_2O$ from highly acid aqueous mixtures of sparingly soluble UO_2 and U_3O_8 by the hydrothermal process yielded impure products with wide ranges of crystal sizes and shapes. Studies on the effect of heating rate on the sinterability of BeO during the calcination in air of $BeC_2O_4 \cdot 3H_2O$ indicated that inferior sintering characteristics were associated with rapid decomposition to $BeC_2O_4 \cdot H_2O$, accompanied by the formation of an unidentified liquid phase. The lithium content of BeO was reduced from 100 to 10 ppm by use of the standard sintering procedure of heating to 1650°C in 1 hr. Phase studies in the systems CaO–BeO, La_2O_3–BeO, SrO–BeO, Y_2O_3–BeO, and MgO–BeO showed that compound formation occurred in all but the MgO–BeO system. In CaO–BeO, a eutectic reaction was indicated at 60 BeO–40 CaO (mole %) and about 1365°C; quenching

liquid of this composition formed a metastable face-centered-cubic phase (a_0 = 14.06 A). Compound formation at 90 BeO–10 CaO (mole %) occurred sluggishly on prolonged heating at 1000°C. In La_2O_3–BeO, a eutectic reaction was observed at 85 La_2O_3–15 BeO (wt. %) and about 1350°C. The oxidation of UC during constant-rate heating in air was observed to occur over a period of 20 to 30 min between 225 and 600°C, rather than instantaneously as was expected. It was found that volume and weight changes during complete oxidation of encapsulated UC were small so that reaction products could be retained. Twelve specimens of Cr-Al_2O_3 fueled with 0.5 g of fully enriched UO_2 were prepared for use in ORR irradiation experiments. Procedures for the preparation of high-density low-porosity graphite bodies were developed through a comprehensive investigation of fabrication variables. The formation of a UO_2 coating on UC particles in fueled graphite prepared by the admixture method and fired in argon was attributed to a reaction between UC and the binder. Bulk densities of 8.5 to 8.7 g/cm^3 were easily obtained by vibratory compaction of granular fused ThO_2–3.4 UO_2 (wt. %) in single stainless-steel tubes. Particle-size distribution appeared to be the primary controlling factor. Preliminary studies indicated that densities of at least 8.5 g/cm^3 can be achieved by this method in multitube assemblies. Successful slip casting of ThO_2 was shown to require particles less than 2 to 3 μ in size, with about 50 vol. % below 1 μ and with a solution of tetrasodium phosphate as basic deflocculant. The addition of 3 to 5 vol. % Al_2O_3 to ThO_2 bodies dry pressed and fired at 1700°C in air resulted in slightly increased bulk density, low porosity, and significant enhancement of the abrasion resistance. These effects were attributed to the formation during sintering of a hard coating of an Al_2O_3-rich eutectic mixture on the ThO_2 particles. The performance of an apparatus designed to measure the thermal conductivity of refractory oxides by the steady-state method was evaluated by use of ingot iron specimens. Data for this material in the temperature range 600 to 1000°C were consistent and agreed well with the data of previous investigators. More than 1000 references to reports and articles relating to thermal properties of refractory reactor-fuel materials were compiled, and about one-half of the references have been abstracted. A mercury-vacuum system for the accurate determination of bulk density of small (approximately 2 cm^3) low-porosity ceramic bodies was designed and is being built. Preliminary experiments indicated that the resin embedding technique holds promise as a reliably accurate means for determining bulk densities of granulated materials. (auth)

536 ORNL-2988 (p.213-20)
Oak Ridge National Lab., Tenn.
FUELS EVALUATION. J. L. Scott, D. F. Toner, et al.

The release-rate parameter for Xe^{133} was measured for approximately 95% dense UO_2 pellets from different vendors over the temperature range of interest in the Experimental Gas-cooled Reactor. The experimental method used consisted in a low-temperature in-pile activation of the fuel followed by an out-of-pile high-temperature anneal. Results showed that the mechanism of release below the sintering temperature consisted in an initial rapid "burst" of xenon followed by a slower diffusion-controlled release which increased with temperature. Preliminary values of the release-rate parameter ranged between 10^{-10} and 10^{-14} sec^{-1} at 1400°C. Preliminary results also indicated that the activation energy for diffusion of Xe^{133} from UO_2 was in the range 47 to 100 kcal/mole. Above the sintering temperature, release-rate parameters were higher than would be expected if diffusion controlled. These high values might be explained by vaporization of UO_2. (auth)

537 ORNL-2988 (p.221-43)
Oak Ridge National Lab., Tenn.
MATERIALS COMPATIBILITY. E. E. Hoffman, W. H. Cook, et al.

Thirty-one different grades of graphite were tested for their permeability by molten fluorides in 100-hr screening tests at 1300°F and 150 psig. Four grades, B-1, S-4-LB, GT-123-82, and CS-112-S, had less than 0.5% of their bulk volume permeated by molten fluorides in the screening test. It appears that, for some grades of graphite, significant decreases in molten fluoride salt permeation can be accomplished by proper pressure reductions. Moderately low-permeability grades of graphite (R-4 and S-4) were permeated to the same extent by molten fluorides under 150 psig at 1300°F after 1-hr exposures as they were in 100-hr exposures. Grade AGOT graphite was impregnated with molten bismuth and subsequently subjected to a standard fuel-permeation test. Results showed that the bismuth pretreatment suppressed the fuel pickup, but the bismuth was not completely retained in the graphite pores during the fuel-permeation test. Two tests were conducted to remove the oxygen contamination from graphite. Past tests showed that a portion of the uranium in LiF-BeF_2-UF_4 (62-37-1 mole %, fuel 130) precipitates as UO_2 when this fuel is exposed to the graphite at 1300°F in a vacuum. A 50-hr exposure of AGOT grade graphite to hydrogen preheated to 1300°F failed to detectably decrease the oxygen contamination. However, purging the graphite with molten fuel 130 or thermally decomposing crystals of ammonium bifluoride inside the graphite crucible apparently was successful in removing the oxygen contamination. INOR-8 was carburized to a depth of 14 mils while in direct contact for 3400 hr with grade TSF graphite in NaF-ZrF_4-UF_4 (50-46-4 mole %, fuel 30) at 1300°F. Three nickel-base brazing alloys, an 82% Au–18% Ni alloy, and pure copper showed good corrosion resistance to LiF-BeF_2-UF_4 (62-37-1 mole %, fuel 130) at 1300°F during a 10,000-hr thermal-convection-loop test of brazed INOR-8 joints. The commercial nickel-base alloys were corroded when used with Inconel as the base metal. Initial corrosion studies on experimental Au-Ni-Ta alloys indicated that they have good resistance to fuels based on both NaF-ZrF_4 and LiF-BeF_2. These alloys are being developed to investigate possible graphite-to-graphite and graphite-to-metal joining methods. Studies to determine the compatibility of type 304 stainless steel and beryllium in a NaK environment were conducted at 1112, 1292, and 1472°F (600, 700, and 800°C). A transfer of beryllium to the stainless steel occurred. The amount of transfer depended on the separation distance between the two materials, the greater transfer occurring where the separation was least. A program was initiated to investigate the compatibility of boiling potassium with several potential container materials at 1600°F. Refluxing potassium capsule tests on Inconel and types 310 and 316 stainless steel were conducted for periods of 500 hr. Metallographic and weight-change data indicate no significant corrosion in the various zones of the test systems. A boiling-potassium–type 316 stainless-steel loop test was operated at a boiler temperature of 1550°F for 200 hr. The results indicated no attack on the loop or specimens suspended in the loop. An additional test with a boiler temperature of 1600°F has operated for 1800 hr and will be operated for 1200 more hours. The potassium-vapor flow rate in this loop is approximately 54 fps. A program was initiated to study mass transport in systems in which the circulating fluid is a liquid

metal. Tests will be included to obtain the solubility of container materials in an alkali metal and the rate of solution of the container material. Thermal-convection-loop studies will follow. A thermal-convection loop was operated with sleeve type insert specimens lining the hot and cold sections of the loop. Results indicate that the use of insert specimens is a satisfactory method of evaluating mass transfer quantitatively in a thermal-convection-loop system. (auth)

538 ORNL-2988 (p.283-430)
Oak Ridge National Lab., Tenn.
METAL FORMING AND CASTING. R. J. Beaver, W. J. Kucera, et al.

Material development work during the past year can be categorized into three areas: (1) aluminum-base fuel elements for low- and medium-temperature reactor applications, (2) stainless-steel-base components for medium-temperature reactors, and (3) beryllium tubing and uranium monocarbide arc-melted shapes for high-temperature systems. In the low-temperature aluminum-base research reactor field, it was concluded that a dispersion of U_3O_8 in aluminum is an attractive fuel material in applications limiting the U^{235} enrichment to 20% after demonstrating that the conventional plate type fuel element can be fabricated relatively economically even though 1000 g of uranium is required per fuel element. This conclusion was based on data obtained from fabricating more than 70 experimental fuel elements for the pool type reactor at the Puerto Rico Nuclear Center. Studies on the irradiation behavior of both UO_2 and U_3O_8 as a dispersoid in aluminum with and without a boron additive, for high-specific-power applications in the low- and medium-temperature range, showed that both the fissile compound and the boron can be incorporated in aluminum by powder-metallurgy processing with acceptable homogeneity. The alloy type X8001 is of interest for medium-temperature reactors. Current results reveal that although conventional tests of roll-bonded X8001 material indicate achievement of metallurgical bonding, blisters develop at the bonded interface at the periphery of roll-clad plates when the specimens are subjected to autoclave tests at 290°C. Considerable effort in the aluminum-base medium-temperature reactor field was directed toward development of a 600-plate fuel element for the High Flux Isotope Reactor, which is designed to operate at a heat flux of 1.5×10^6 Btu · hr^{-1} · ft^{-2} and a neutron flux in the trap of 5×10^{15} neutrons · cm^{-2} · sec^{-1}. The reference fuel material is an aluminum-base alloy containing 30 wt. % U–2.0 wt. % Si–0.05 wt. % B. Preliminary results indicate that boron and uranium can be distributed uniformly in 30 wt. % U–2 wt. % Si–0.05 wt. % B–Al alloy, that the fuel material can be roll clad into composite plates, and that the plates can be marformed into an involute shape and mechanically joined between two concentric tubes into a fuel-element array. In the development of fuel, neutron absorbers, and burnable poison materials for medium-temperature water-cooled and -moderated reactors, studies on UO_2 swage clad with austenitic stainless steel showed that internal cracking of the stainless-steel cladding is a problem when working with temperatures above 600°C and reductions in area greater than 65%. Postirradiation results on full-size plate-type UO_2-stainless-steel fuel elements revealed no significant damage in material containing 26 wt. % UO_2 after a maximum burn-up of 32% at 260°C in the SM-1 reactor. Postirradiation examination of full-size 3 wt. % B–Fe neutron absorbers from this reactor showed evidence of significant damage to the material after 18 at. % burn-up of the B^{10}. However, calculations based on a boron gradient design indicated that it may be possible to increase the B^{10} burn-up to 25 at. % burn-up with no damage. Studies on the compatibility of boron and boron compounds in stainless steel revealed reactions between SrB_6 and YB_6 and the austenitic stainless steel. It was also demonstrated that 4 wt. % elemental boron was compatible in type 200 stainless steel powder metallurgy compacts but not with type 347 stainless steel. Additional work on dispersions of Eu_2O_3 indicated that characteristics of the basic oxide may be responsible for swelling during sintering of austenitic-stainless-steel compacts containing dispersions of this material. Additional work on the UO_2-type 430 stainless-steel irradiation program was limited to fuel element design. Development in the high-temperature sodium-cooled reactor field demonstrated that flat thick-plate stainless-steel fuel elements, containing a dispersion of 33 wt. % spherical UO_2 can be fabricated and that uranium alloys containing 10 to 17 wt. % Mo can be vacuum-induction melted and extruded into rod with no difficulty. Gas-cooled development included procurement of beryllium tubing produced by various fabricators and the establishment of a subcontract with Nuclear Metals, Inc., to evaluate various extrusion parameters involved in the fabrication of beryllium tubing. Arc-melted uranium monocarbide shapes were also prepared in support of an irradiation-testing program of this highly regarded fuel compound. (auth)

539 ORNL-2988 (p.443-52)
Oak Ridge National Lab., Tenn.
POWDER METALLURGY AND FUEL CYCLE. J. P. Hammond, S. A. Rabinowitz, et al.

Attempts are being made to develop a fuel material consisting of UO_2 or UC dispersed in a U-Mo, γ-uranium matrix. Limited success in cold pressing UO_2 with pre-alloyed U-Mo powders was realized, but considerable difficulty was experienced in sintering these compacts. High densification of U–10 wt. % Mo powders was obtained through swaging, but the bonding between particles was poor. Work is continuing to improve fabrication for these materials. Experiments were performed to develop fuel cores having a desired fuel concentration and a constant loading of burnable poison. Direct cold pressing of fuel cores and filler pieces was employed in obtaining cores which contain U_3O_8, B_4C and aluminum. To improve dimensional and density control of the pressings, the die top is being fitted with a gage for precision spacing of the powder level prior to pressing. Investigation of boronated glasses as burnable poisons was started as a part of the Army Package Power Reactor (APPR) Program. When normal Pyrex glass was rolled in stainless steel, severe stringering occurred. Two programs aimed at development of advanced fuel materials were initiated. Fabrication of uranium monocarbide bodies by liquid-phase sintering with nickel, vanadium or U_3Si_2 as binder is expected to lead to improved density and performance characteristics. The mechanical and irradiation properties of γ-uranium (containing 10 to 15 wt. % Mo) and thorium alloys, strengthened by fine-particle dispersion, will be studied. (auth)

540 ORO-319
Carborundum Co. Research and Development Div., Niagara Falls, N. Y.
SYNTHESIS AND FABRICATION OF REFRACTORY URANIUM COMPOUNDS. Monthly Progress Report No. 9 [for] August 1 through August 31, 1960. K. M. Taylor and C. H. McMurtry. Sept. 12, 1960. 4p. Contract AT(40-1)-2558. OTS.

Several synthesis experiments were carried out including production of a 3-lb batch of U_3Si_2 by the previously de-

scribed nonquenching method. Test data indicate that the use of graphite crucibles in syntheses increases the specimen carbon content. In other work, inconsistency between x-ray and metallographic-examination results of U_3Si_2 is being investigated. The fabrication of U_3Si_2 bars for physical testing was continued during the period. Synthesis of UN is reported in which pellet densities of 12.71 g/cm^3 (14.31 theoretical) were produced. Further sintering experiments on UC are also described, and data are given. (For preceding period see ORO-276.) (J.R.D.)

541 TID-6481

Bureau of Mines. Boulder City Metallurgy Research Lab., Nev.

ELECTROCHEMICAL STUDIES OF HAFNIUM, ZIRCONIUM AND YTTRIUM; PURE METALS PROJECT: HAFNIUM, ZIRCONIUM AND YTTRIUM PROGRAM. Quarterly Progress Report No. 11 [for] April 1, 1960 to June 30, 1960. 5p. Contract AT(11-1)-475. OTS.

Electrolysis studies indicated that low conversion was taking place from the zirconium carrier ion to a hafnium carrier ion. Large acicular crystals of yttrium were produced at a rapid rate in the LiCl–KCl–YCl bath. (For preceding period see TID-6480.) (C.J.G.)

542 UCRL-6110

California. Univ., Livermore. Lawrence Radiation Lab.

MOLYBDENUM, NIOBIUM, TANTALUM, TUNGSTEN AND URANIUM OXIDE IN THE JOURNAL LITERATURES OF THE USSR, 1955–JUNE 1960. Carl J. Wensrich. Sept. 1, 1960. 32p. Contract W-7405-eng-48. OTS.

A bibliography is presented on the properties, separation, and fabrication of Mo, Nb, Ta, W (and their alloys), and UO_2. (C.J.G.)

543 AEC-tr-4268

ACTION OF LOW-ENERGY ARGON IONS ON URANIUM SURFACES. (Action des Ions Argon de Faibles Energies sur des Surfaces D'Uranium). Pierre Haymann. Translated by Gretchen Riese and Robert McDonald (Los Alamos Scientific Lab.) from Compt. rend. 248, 2472-4(1959). 5p. JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 13589.

544 JPRS-5179

PRODUCTION AND PHYSICAL METALLURGY OF PURE METALS. PART VII. Yu. F. Bychkov, A. N. Rozanov, D. M. Skorov, V. S. Lyashenko, Yu. F. Babikova, and P. L. Gruzin. Translation of Met. i Metalloved. Chistykh Metallov, No. 1, p.179-212(1959). 45p. OTS.

545 JPRS-5179(p.18-27)

CONCERNING THE REGULARITY OBSERVED IN THE CHANGE OF VOLUME DURING FORMATION OF INTERMETALLIC COMPOUNDS. V. S. Lyashenko. Translated from Met. i Metalloved. Chistykh Metallov No. 1, 192-9 (1959).

A discussion of the mechanism of volume charge which usually accompanies formation of intermetallic compounds is presented. It is concluded that a single electron of the element determines the change. In the formation of a band in the crystal lattice of the compound, not only electrons of the outer shells but also electrons of deeper-lying shells participate. However, the volumes of isostructural compounds containing alkali metals can be established in accordance with their atomic volumes. (J.R.D.)

546 SCL-T-328

CURRENT DEVELOPMENTS IN ULTRASONIC TREATMENT OF SOLID-BODY SURFACES. (Heutiger Stand der Ultraschall-Behandlung von Festkörper-Oberflächen). Hans Joachim Gollmick. Translated by Marcel I. Weinreich (Sandia Corp.) from Industrieblatt 59, 200-4(1959). 14p. JCL.

The treatment and theory of cleaning solid surfaces by ultrasonic methods are discussed. The use of ultrasonics in boring, metal coating, and removing scales is briefly described. (W.L.H.)

547

CORRECTION AND INTERPRETATION OF FOURIER COEFFICIENTS OF X-RAY DIFFRACTION PATTERNS FROM VERY SMALL, DISTORTED CRYSTALS. D. H. Kobe (General Electric Co., Richland, Wash.). Acta Cryst. 13, 767-9(1960) Oct. 10. (In English)

A method is presented for correcting the Fourier coefficients of (001) x-ray diffraction patterns from powders of very small, distorted crystals to take into consideration a function of the diffraction angle that should multiply the Fourier series. The function, which is usually assumed constant, is the product of the crystal structure factor, the polarization factor, and the Lorentz factor and can vary greatly over the diffraction peak in some cases. The corrected coefficients must then be separated into the particle size coefficients and the distortion coefficients. A method for obtaining the discrete particle size distribution function directly from the particle size coefficients is presented. The distortion coefficients are used to determine the moments of the distortion, from which the probability density functions for the distortion can be obtained by means of a Gram-Charlier series. (auth)

548

DETERMINATION OF LATTICE PARAMETERS WITH THE AID OF A COMPUTER. Melvin H. Mueller, LeRoy Heaton, and K. T. Miller (Argonne National Lab., Ill.). Acta Cryst. 13, 828-9(1960) Oct. 10. (In English)

A least squares method is described which permits the determination of lattice parameters and standard errors for the orthorhombic system and all other crystal systems of higher symmetry. The angular measurements of lines or spots of several different wave lengths may be used. Provision was made for using as many as three separate correction terms for eccentricity, absorption, divergence, and other variables. Experience has indicated that a weighting factor usually gives a better fit with a smaller standard error. Since a problem can be solved in a short time, it is usually advantageous to obtain several solutions to the problem using various combinations of correction terms and weighting factors in order to verify the fitting process and the accuracy of the lattice parameters. (B.O.G.)

549

ZIRCONIUM AND ZIRCONIUM ALLOYS AS CONSTRUCTION AND CANNING MATERIALS IN SHIP REACTOR CONSTRUCTION. L. Bangert (W. C. Heraeus G.m.b.H., Hanau, Ger.). Atomwirtschaft 5, 408-11(1960) Sept. (In German)

The properties of zirconium and zirconium alloys that justify their utilization in maritime reactors are reviewed. Zr–Sn and Zr–Nb alloys are especially considered. The production and manufacture of these materials are briefly considered, and the soldering compounds used with them are described. The economic aspects of the use of zirconium in reactors are discussed. (J.S.R.)

550

DIRECT REPLICA TECHNIQUE FOR COPPER. J. O. Stiegler and T. S. Noggle (Oak Ridge National Lab., Tenn.). J. Appl. Phys. 31, 1827-8(1960) Oct.

A direct replica technique for the electron-microscope examination of metal surfaces was developed for preshadowed carbon replicas of copper surfaces. This nondestructive method involves the dissolution of the thin oxide layer normally present on copper surfaces in a dilute aqueous solution of ethylenediamine. The stripping action was speeded up by exposing the replicated surface to the fumes of concentrated nitric acid prior to immersion in ethylenediamine. This technique was employed in a study of the effect of reactor irradiation on deformations in copper. (M.C.G.)

551

FUSED SALT ELECTROREFINING OF BERYLLIUM. M. M. Wong, R. E. Campbell, and D. H. Baker, Jr. (Bureau of Mines, Boulder City, Colo.). J. Metals 12, 786-8(1960) Oct.

Beryllium was successfully electrorefined in a fused salt cell with an inert gas atmosphere and a graphite liner at 450 or 550°C. The fused salt was a LiCl–KCl eutectic to which $BeCl_2$ was added. The depositing cathode was an iron rod and the anode was an iron basket containing crude beryllium metal. After deposition, the cathode deposit was cooled and stripped from the cathode, leached in dilute HNO_3, washed, and dried. Analyses of the dried deposits showed that all the impurity elements except C were reduced; Mg, Ni, Al, and Cr were reduced to negligible contents, whereas O, Si, Fe, and N were appreciably reduced; but Mn and Cu were not removed to a large extent. The purity compares favorably with that of high-purity beryllium prepared in other ways. (D.L.C.)

552

NUCLEAR PURITY BERYLLIUM—ITS MANUFACTURE. C. W. Schwenzfeier, Jr. (Brush Beryllium Co., Cleveland). J. Metals 12, 793-7(1960) Oct.

The various production steps involved in producing beryllium from beryl are described in detail. The fluoride–thermal reduction process as the final step compared favorably, so far as purity is concerned, with the chloride–electrolysis process. The steps described include: (1) ore extraction by melting the ore, adding H_2SO_4 to the quenched frit to dissolve beryllium, and precipitating beryllium hydroxide (the alkali-metal double-fluoride sintering process is also described); (2) preparation of beryllium fluoride by dissolving the hydroxide in an NH_4HF_2 solution, precipitating heavy metal impurities, crystallizing the ammonium beryllium fluoride salt, and thermally decomposing the salt; (3) reducing the fluoride by magnesium; and (4) vacuum casting to remove residual magnesium and slag. (D.L.C.)

553

HIGHER PURITY INGOT CERIUM FROM MOLTEN SALTS. B. Porter, E. S. Shedd, C. Wyche, J. D. Marchant, and R. G. Knickerbocker (Bureau of Mines, Reno, Nev.). J. Metals 12, 798-801(1960) Oct.

Results are reported from work being done on electrowinning cerium in fused fluoride baths. Oxygen gas was identified in the inert atmospheres used in the electrowinning chambers and appears to be produced by the electrolytic reaction itself. The quadrivalent state of cerium could not be the only species reduced to the metal; trivalent cerium ions probably are reduced. Nodule formation, instead of one large ingot, appears when cerium oxide feed into the bath is intermittent and when the current is interrupted. The electrowinning procedures for aluminum and cerium are compared. The analysis of high-purity reactive metals is outlined. (D.L.C.)

554

PLUTONIUM, A NUCLEAR FUEL. E. Grison (Centre d'Études de l'Énergie Nucléaire, Fontenay-aux-Roses, France). Métaux (Corrosion–Inds.) 34, 18p.(1959) Oct. (In French)

A review is given of the physical properties of metallic plutonium, its preparation, and its alloys with the principal nuclear metals. Its value as a nuclear fuel is discussed. (tr-auth)

555

THE APPLICATION OF RADIOACTIVE ISOTOPES TO THE RADIOGRAPHIC RESEARCH OF METALS. B. Osuchowski. Nowa Tech. No. 7, 5-26(1956). (In Polish)

The preparation and utilization of both natural and artificial radioactive emitters for the production of gamma rays suitable for scanning and inspecting thin and thick metallic materials are discussed, and a description of a defectoscope, based on gamma-ray transmission and used for detecting defects and flaws in castings and welds, is given. Techniques and results of operating the defectoscope as well as comparisons with x-ray inspections of similar materials are presented. A convenient table entitled "Properties of Isotopes Useful in Metals Research" is included. 12 references. (TTT)

556

IONIZATION METHODS USED WITH THE GAMMA-RAY "DEFECTOSCOPE" APPLIED TO THICK METAL OBJECTS. I. G. Fakidow and A. A. Samochwałow. Nowa Tech. No. 7, 27-37(1956). (In Polish)

A gamma-ray defectoscope is described where an ionization counter is substituted for photographic plates. The type of counter used depends on the application and includes scintillation, self-quenching, and gas-mixture filled counters as well as G.M. counters. The defectoscope essentially measures the collimated gamma transmission characteristics of a metal sample as detected by a suitably windowed (collimated) counter. Sample thicknesses of the order of 250 to 300 mm were handled by the defectoscope and thin defects of the order of 3% of the control thickness were detected. (TTT)

557

American Society for Testing Materials, Philadelphia. SYMPOSIUM ON NEWER METALS. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272. 1960. 222p. $7.50.

The symposium was conducted in three sessions. The first session, Properties of Refractory Metals, included papers on high-temperature testing methods and properties of molybdenum, tantalum, niobium, and the platinum metals. The second session, Nuclear and Light Metals, contained papers on beryllium, yttrium, and zirconium. The third session, Processing of Newer Metals, was concerned with purification and fabrication of niobium, tantalum, molybdenum, chromium, and lithium. In addition to the orally presented papers, the paper "Coulometric Determination of Tin with Electrolytically Generated Iodines: Application to Analysis of Zircaloy," is included to supplement the information given on test methods and properties of the Zircaloy alloys. Separate abstracts were prepared for thirteen papers of the fifteen papers included. (B.O.G.)

558

STEELS HAVING A HIGH BORON CONTENT. (to Campagnie des Ateliers et Forges de la Loire). British Patent 842,951. July 27, 1960.

Steels with boron contents up to 5% can be made for

forging, rolling, and other heat treatments by incorporating 2 to 4% silicon. However, the operations must be initiated at 1020 to 1070°C and terminated above 900°C. (D.L.C.)

559

COATING FOR URANIUM FUEL ELEMENTS. Henry Andrew Saller, John Robert Keeler, and Edwin Robert Szumachowski (to United Kingdom Atomic Energy Authority). British Patent 849,898. Sept. 28, 1960.

Zirconium–tin alloys in the range 1 to 15% tin have advantages for use as coatings or casings for uranium fuel elements, viz., low neutron capture cross section and high corrosion resistance. Several ways of preparing such alloys are given. Corrosion rate data are given for a large number of Zr–Sn alloys, using 315°C water and 400°C steam at 1500 psi, which demonstrate their increased corrosion resistance over that of pure zirconium, except for alloys with high tin contents on the order of 25%. As an example of coating fuel elements with Zr–Sn alloys, a Zr–U^{235} fuel block can be encased in a Zr–Sn block and covered with two Zr–Sn plates, bonding being effected by rolling. (D.L.C.)

Corrosion

560 ARF-2152-13

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

A MECHANISM FOR STRESS-CORROSION EMBRITTLEMENT. Summary Report [for] August 1, 1959–July 31, 1960. Rodney P. Elliott and Robert H. Read. Sept. 14, 1960. 24p. Contract Nonr-2602(00).

The stress level for crack formation as a function of grain size was investigated for a number of alloys. Stress-corrosion embrittlement of Al–4 wt. % Cu in $NaCl–H_2O_2$ solution at room temperature and Armco iron in boiling $Ca(NO_3)_2–NH_4NO_3$ solution was investigated. The stress for crack formation as a function of grain diameter for these alloys was found to be rectified in accordance with the Petch equation. From the slopes of data, surface energies of 160 and 32 ergs/cm^2 were calculated, respectively, for the aluminum–copper alloy and the Armco iron. These values of surface energy represent appreciable reduction from surface energy in a nonstress corroding medium and therefore support the hypothesis that stress corrosion is a brittle fracture phenomenon. (See also ARF-2152-10.) (auth)

561 CF-60-8-120

Oak Ridge National Lab., Tenn.

OPERATION OF HRP IN-PILE CORROSION TEST LOOP 0-1-25. V. A. DeCarlo and R. A. Lorenz. Aug. 24, 1960. 36p. OTS.

The performance and operation of Loop 0-1-25, an in-pile corrosion and coolant testing loop, in beam hole HN-1 of the ORNL Research Reactor are reported. The loop was operated for 2575 hr of uranyl sulfate fuel solution and 30,598 Mw-hr reactor operation. Main-stream temperature of the loop was 280°C and the pressurizer temperature was operated at 295, 305, and 310°C. Performance of the loop, auxiliary equipment, and instrumentation was satisfactory. (C.J.G.)

562 DP-486

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

CORROSION OF STAINLESS STEEL IN HNO_3–HF SOLUTIONS. Patricia M. Kranzlein. July 1960. 32p. Contract AT(07-2)-1. OTS.

Studies were made on the safe handling of HNO_3–HF solutions in 304 L and 309SCb stainless-steel equipment under carefully controlled conditions. The corrosion behavior of both wrought and welded 304L and 309SCb was investigated in various HNO_3–HF solutions, ranging in HNO_3 concentration from 0 to 10.0 M and HF concentration from 0.01 to 1.5 M, at temperatures from 24°C to the boiling point. (auth)

563 M-6911

Knolls Atomic Power Lab., Schenectady, N. Y. and Babcock and Wilcox Co. [Research Center], Alliance, Ohio.

CAUSTIC STRESS CORROSION OF TYPE 347 STAINLESS STEEL. G. C. Wheeler and Earl Howells. [1957]. 14p. OTS.

The corrosion of type 347 stainless steel by aqueous solutions of NaOH and solutions of NaOH (16 to 60%) in sodium was studied on uranium-bend specimens, stress-rupture specimens, and miniature boilers at 650 to 850°F. The aqueous solution produced stress-corrosion cracking at 650°F and the NaOH in sodium solution produced cracking at 850°F. The addition of sufficient disodium phosphate delayed or in some instances prevented cracking in dilute aqueous solutions. (C.J.G.)

564 MND-P-2128

Martin Co. Nuclear Div., Baltimore.

SNAP I—DYNAMIC MERCURY LOOP TESTS OF SELECTED MATERIALS. [Period covered]: January 1957–June 1959. John McGrew. Mar. 1960. 45p. Contract AT(30-3)-217. OTS.

Six dynamic boiling-mercury loops were tested in connection with the SNAP-I program. The loops were Croloy-5 Si, Croloy-5 Ti, Carpenter 20 Nb, Types 347 and 446 stainless steel and a Type 347 stainless-steel-clad niobium boiler coil inserted into the Type 347 stainless-steel loop. Operation of the Croloy-5 Si loop was discontinued after about 86 hr because the heaters burned out. Extensive general corrosion which penetrated as much as 3.5 mils occurred during this time. The boiler-outlet leg of the Croloy-5 Ti loop ruptured after 166 hr of operation. Again, extensive general corrosion occurred with up to 5 mils penetration. The Carpenter 20 Nb loop was never operated at design conditions. It failed after a short time when arcing from the heater to the coil burned through the tubing. The Type 347 stainless-steel loop failed after 326 hr when the outlet leg of the boiler coil ruptured. Extensive depletion of nickel with penetrations up to 20 mils was found in the condenser. The Type 446 stainless-steel loop did not fail. Its operation was discontinued after 141 hr because of multiple leaks. Numerous transgranular cracks were found in the boiler coil, but the origin of these cracks was problematical. The remainder of this loop was apparently unaffected. The niobium coil ruptured after 50 hr of operation. The failure was probably caused by atmospheric oxygen, which contacted the niobium when the Type 347 stainless-steel cladding failed. Successful operating experiences involving two-phase mercury flow and totalling more than 500 hr were obtained using Type 316 stainless-steel tubing. Operating conditions for the mercury working fluid at the inlet of this tubing were 200 psia and 1100 to 1350°F. (auth)

565 NP-9241

Carnegie Inst. of Tech., Pittsburgh.

STRESS CORROSION CRACKING OF SINGLE CRYSTALS OF SOME AUSTENITIC STAINLESS STEELS. R. E. Reed and H. W. Paxton. Oct. 1, 1960. 36p. Contract Nonr 760(14).

Crack nucleation site, orientation of the crack plane, fracture time-stress relationship, fracture surface morphology, and corrosion product composition were studied during the stress corrosion cracking of austenitic stainless-steel single crystals. Fe–20 wt.% Cr–20 wt.% Ni, Fe–20 wt.% Cr–12 wt.% Ni, and commercial type 304 stainless-steel single crystals were loaded in tension in boiling 42% $MgCl_2$ solution. The commercial type 304 stainless steel cracked or fractured in 4 to 17 hr, the Fe–20 wt.% Cr–12 wt.% Ni in 16 to 62 hr, and the Fe–20 wt.% Cr–20 wt.% Ni in 70 to 170 hr. The crack in all three alloys nucleated from elongated pits formed when portions of slip lines were attacked by the solution. The crack plane of the Fe–20 wt.% Cr–20 wt.% Ni specimens followed the (100) plane with the highest normal stress upon it. Electron diffraction patterns made of the corrosion product from a Fe–20 wt.% Cr–20 wt.% Ni crack face showed that it may be a chromium-iron oxide. Colorimetric analysis of the corrosion solution showed an increase in nickel during the test. The general crack plane in type 304 and Fe–20 wt.% Cr–12 wt.% Ni specimens was approximately normal to the tensile axis. (auth)

566 ORNL-1491
Oak Ridge National Lab., Tenn.
CORROSION BY MOLTEN FLUORIDES. Interim Report. L. S. Richardson, D. C. Vreeland, and W. D. Manly. Sept. 1952. Decl. May 9, 1960. 20p. Contract W-7405-eng-26. OTS.

Static and dynamic tests were made on corrosion of stainless steels, Stellite, Nichrome, Inconel, Monel, Ta, Nb, Fe, V, Mo, and Ni alloys by molten NaF–KF–UF_4 and KF–LiF–NaF–UF_4 systems. Data on the effects of time, cold work, heat treatment, and numerous additives on corrosion rates and depth of metal affected are presented. (auth)

567 ORNL-2988(p.61-84)
Oak Ridge National Lab., Tenn.
REACTIONS AT METAL SURFACES. J. V. Cathcart, G. F. Petersen, and R. E. Pawel.

Studies of the role of strain in the oxide films in the oxidation of metals were continued. The research consisted of (1) an investigation of the strain-induced anisotropy in thin cuprous oxide films on copper single crystals, and (2) a study of "break-away" phenomena in the oxide films on niobium single crystals. Oxide films on the (110) and (311) planes of copper exhibited optical anisotropy while those on the (111) and (100) planes did not. A marked variation in the degree of anisotropy as a function of film thickness was also noted for oxide films on the (110) and (311) planes. A tentative explanation of these results based on the expected character of epitaxially induced strains between the oxide and metal was presented. Oxidation-rate measurements and oxide morphology studies on single-crystal specimens of niobium indicated that the process of gaseous oxidation in the temperature range 400 to 425°C was particularly dependent upon the crystallographic orientation of the metal. Specimens oriented within about 25° of (100) oxidized, at least in the initial stages, at a much slower over-all rate than that for the remaining orientations. These differences in oxidation characteristics were attributed in part to the effect of substrate orientation on the manner in which the transition from protective to nonprotective oxidation behavior occurred. (auth)

568 ORNL-2988(p.197-212)
Oak Ridge National Lab., Tenn.
CORROSION ENGINEERING. J. H. DeVan, R. C. Schulze, et al.

A three-phase out-of-pile corrosion-test program is continuing in order to evaluate the behavior of Inconel and INOR-8 in contact with fluoride salt mixtures. Results of the tests completed to date show Inconel to be quite susceptible to the corrosive attack of the various fused fluoride mixtures, whereas INOR-8 continues to show excellent corrosion resistance. Inserts contained in an INOR-8 forced-convection test at the point of maximum temperature exhibited weight losses of 1.7 to 2.1 mg/cm^2 during a 15,000-hr period. A materials-compatibility program is in progress to study effects of contaminants outgassed from graphite on structural materials to be incorporated in the Experimental Gas-cooled Reactor. Polythermal static pot tests were completed with type 304 stainless-steel specimens heated to temperatures as high as 1800°F. The nature of the reaction films found on these specimens was strongly influenced by the total metal-surface area within the test chambers. Low-pressure thermal-convection loops were operated with impurity levels continuously maintained in the range of the Experimental Gas-cooled Reactor specifications. Stainless steels demonstrated excellent compatibility with the environments in the latter tests, but reaction films formed on low-alloy steels were relatively heavy and as a consequence were subject to spalling. Effects of gas pressure and velocity on compatibility were investigated and found to be inconsequential. A test apparatus is being assembled to provide an evaluation of carburization occurring in graphite-metal couples under various contact pressures. (auth)

569 ORNL-2988(p.421-35)
Oak Ridge National Lab., Tenn.
PHYSICAL METALLURGY. H. Inouye, W. J. Werner, and D. O. Hobson.

Compatibility studies of type 304 stainless steel with low concentrations of CO and CO_2 indicated that carburization may be governed by the equilibria Fe-Fe_3C-CO-CO_2. Unlike iron, stainless steel appeared to oxidize irrespective of the CO and CO_2 concentrations or their ratios. The oxides which formed in CO_2 atmospheres spalled upon cooling and thus may be a problem when present as particles in a high-velocity helium stream. Adherent oxides were formed at high CO/CO_2 ratios. Beryllium reacted with CO_2 to form a protective film of BeO. The superficial nature of the BeO remained unchanged during reaction times up to 1000 hr. An increase in the CO_2 pressure by a factor of 10^6 resulted in only a slight increase in the reaction rate. Thermodynamic calculations of possible reactions of molybdenum with gases were made. The data showed that from the standpoint of oxidation, the metal can be exposed to wet hydrogen and to certain CO/CO_2 compositions. The feasibility of exposing the metal to high concentrations of CO_2 depends upon the properties of MoO_2. The oxidation of unalloyed niobium in oxygen at pressures between 3×10^{-5} and 5×10^{-3} mm Hg and temperatures of 850, 1000, and 1200°C proceeded principally by solution of oxygen, internal oxidation, film formation, and by an oxide-gas reaction. Characteristic rate curves for each of the oxidation stages were observed and correlated with the formation of Nb–O solid solutions, NbO, NbO_2, and Nb_2O_5. The four oxidation stages were found to be dependent on temperature, pressure, and time. Three different linear and two parabolic reaction rates were observed. The rate-controlling reactions were governed by the adsorption of oxygen, by diffusion of the reactants through a protective NbO_2 layer, and by a reaction between NbO_2 and oxygen to form Nb_2O_5. Under the proper conditions of time and temperature, Nb–nominal 1% Zr alloys will undergo an aging reaction which causes an increase

in the tensile properties and a decrease in the ductility of the metal. Data were obtained on the aging characteristics of Nb-Zr alloys ranging from 0.6 to 1.25% Zr. Of these alloys, five showed definite aging and four showed no aging response. A correlation was found between the aging response and the impurity levels of carbon, oxygen, and nitrogen in the alloys. The aging apparently results from the precipitation of nitrides and/or carbides of zirconium. When sufficient oxygen is present in the alloy the aging reaction is neutralized. (auth)

570 TID-6215

Battelle Memorial Inst., Columbus, Ohio.

THE CORROSION OF THE INCONEL HF INLET AND SALT OUTLET LINE OF THE MK II DISSOLVER. F. W. Fink. July 20, 1960. 11p. OTS.

The corrosion of the Inconel HF inlet and salt outlet line of the Mk II dissolver is discussed. A failure occurred in the line that was exposed to a $LiF-NaF-ZrF_4$ salt at temperatures up to 700°C. The mechanism of attack appeared to be the leaching of chromium and the formation of a porous structure rich in nickel. HF appeared to be the active corroding ingredient in the system. (C.J.G.)

571 TID-6418

Michigan Chemical Corp., St. Louis, Mich.

CORROSION TESTING OF METALS IN THE LIQUID-LIQUID EXTRACTION PILOT UNIT. Report 239. Period [covered]: September 12, 1958 to March 4, 1959. P. A. Lincoln. 10p. Project No. 942. OTS.

A corrosion study was conducted in a liquid extractor pilot unit to determine the action of hydroxyethylethylenediaminetriacetic acid (HEDTA) scrub and the 0.2 to 0.4 N H_2SO_4 and HCl back-extractant solutions used in the process on various corrosion-resistant metals. The results indicate that Nionel, Hastelloy C, and the type 20 alloys could be used, under mild flow conditions, as structural materials with all these solutions. Type 304, 316, 316 low carbon, 317, and 347 stainless steels would be safe for mild flow conditions in all but HCl. Type 317 stainless steel appeared to resist HCl and might be used after further testing. (auth)

572 JPRS-4040

PRINCIPAL METHODS AND APPARATUS FOR INVESTIGATING OXIDATION PROCESSES IN METALS AND ALLOYS. (Osnovnyye Metody i Apparatura Dlya Issledovaniya Protesessov Okisleniya Metallov i Splavov). D. V. Ignatov. Translated from Doklady Inst. Met. im. A. A. Baykova No. 5, 202-37(1960). 49p. OTS.

A description of methods which are useful for investigating the processes of oxidation in metals and alloys is presented. These include structural methods (except radiographic and neutronographic), weight methods, and isotopic methods. Design of test apparatus is discussed and procedures are outlined. (J.R.D.)

573 NP-tr-491

KINETICS AND MECHANISM OF HIGH TEMPERATURE OXIDATION OF TANTALUM IN RECRYSTALLIZED AND COLD-HARDENED STATES. (Kinetika i Mekhanizm Visokotemperaturnogo Okisnyuvaniya Tantalu v Rekristalizovanomu Ta Naklepanomu Stanakh). V. A. (O.) Lavrenko. Translated from Dopovidi Akad. Nauk Ukr. R.S.R., 1079-82(1958). 9p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 7802.

574

CHROMIUM ELECTROPLATES FOR CORROSION PROTECTION OF STRESSED AISI 410 STEEL IN HIGH TEMPERATURE, HIGH PURITY WATER. Henry Suss (Knolls Atomic Power Lab., Schenectady, N. Y.). Corrosion 16, 497t-502t(1960) Oct.

The use of chromium plates for protection of AISI 410 steel against stress corrosion cracking gave anomalous results. The coating either offered protection under conditions that produced failure in unplated material or caused accelerated failures under conditions that did not cause unplated material to fail. Factors which may have contributed to the anomalous results are discussed. Introduction of oxygen into 300°F-water systems caused accelerated stress-corrosion failures, especially for the chromium-plated samples, with applied stresses as low as 60,000 psi. From information presently available the use of chromium deposits is not recommended for corrosion protection of AISI 410 steel materials that are susceptible to stress corrosion and/or intergranular attack. AISI 410 steel tempered at 1125°F minimum, which was not susceptible to stress corrosion failure, indicated insignificant or no pitting attack after 6 weeks exposure in air-saturated water at 300°F. There are no significant advantages in the use of chromium plate to reduce general corrosion attack. There is a possibility that this coating, under certain conditions of application, may promote accelerated pitting attack. Cobalt-base alloys, such as Stellite 6, in contact with chromium-plated AISI 410 steel, tempered at 1125°F minimum, will promote accelerated dissolution of the chromium plate adjacent to juncture between Stellite 6 and chromium plate and pitting of base metal in these areas. No attack of chromium plate in the crevice was noted, but accelerated attack of the base metal through the cracks in the chromium plate was noted in these areas. (auth)

575

A CONTRIBUTION TO THE EXPLANATION OF INTERGRANULAR CORROSION OF CHROMIUM-NICKEL STEEL. V. Cihal and M. Prazak (State Research Inst. for Materials Protection, Prague). Corrosion 16, 530t-2t(1960) Oct.

Intercrystalline corrosion in chromium-nickel steels is considered from both a theoretical and practical standpoint. Laboratory tests were conducted to determine the effect of boiling sulfuric acid containing copper sulfate on Invar alloy and 18 chromium-9 nickel alloy. Specimens subjected to various heat treatment were tested. Polarization curves and passivation potentials of alloys are given. The use of a potentiostat proved helpful in determining intercrystalline corrosion susceptibility, especially for steels with a low carbon content and those containing stabilizing elements that demonstrate only a slight tendency to intercrystalline corrosion. The extent of intergranular corrosion depends on the amount of precipitated chromium carbide and on the redox potential of the solution. (auth)

576

THE HIGH TEMPERATURE OXIDATION OF BERYLLIUM. PART II. THE REACTION WITH CARBON DIOXIDE AND WITH CARBON MONOXIDE. S. J. Gregg, R. J. Hussey, and W. B. Jepson (Univ. of Exeter, Eng.). J. Nuclear Materials 2, 225-33(1960) Sept. (In English)

The chemistry of the reaction of French Flake beryllium with carbon dioxide and with carbon monoxide was investigated at 500 to 750°C by a radioactive tracer technique. The results lead to the conclusion that the following reactions occur: $Be + CO_2 = BeO + CO$; $2Be + CO_2 = 2BeO + C$; and $Be + CO = BeO + C$. It is argued that the beryllium carbide which is present in the oxide layer is formed by the reaction $2Be + C = Be_2C$ and not directly according to

$4Be + CO_2 = 2BeO + Be_2C$ or $3Be + CO = BeO + Be_2C$. There was no evidence for the reaction of carbon dioxide with deposited carbon according to the equilibrium $C + CO_2 \rightleftharpoons 2CO$, nor for the reverse reaction, viz. the decomposition of carbon monoxide to deposit carbon and evolve carbon dioxide. A less detailed investigation suggests that for oxidation in carbon monoxide–carbon dioxide mixtures, there exists a minimal concentration of carbon monoxide above which carbon monoxide also reacts with beryllium. (auth)

577

AN ELECTRON MICROSCOPE STUDY OF GRAPHITE OXIDATION. J. A. Hedley (C. A. Parsons and Co., Ltd., Newcastle Upon Tyne, Eng.). Nature 188, 44-5(1960) Oct. 1.

A study was made of the behavior of lattice or surface imperfections in the oxidation of graphite. Electron microscope observations of thin films heated in air at 600°C showed that attack occurred preferentially at crystal edges and cleavage steps. Further attack occurred inward from the initial points. (M.C.G.)

578

MATERIALS OF CONSTRUCTION FOR HANDLING FLUORINE. Earl L. White and Frederick W. Fink (Battelle Memorial Inst., Columbus, Ohio). p.161-81 of "Proceedings of the Propellant Thermodynamics and Handling Conference, 1959. Special Report 12, Engineering Experiment Station, The Ohio State University."

There is considerable information on the corrosion behavior of materials exposed to fluorine. No material is completely inert to attack by this extremely active element. However, many of the common construction materials, when used in the established temperature ranges, can be expected to give acceptable service. Nickel alloys can be used up to 1200°F; aluminum and magnesium to 900°F; copper, and possibly thorium, to 700°F; pure iron to 600°F; mild steels with low silicon content to 400°F; and titanium and zirconium to 300°F. Chromium plate is useful to at least 400°F and nickel plate to higher temperatures. The use of Ta, Sn, Ag, Pb, and Pt is possible at room temperatures. Silicon, vanadium, rhenium, and uranium are attacked even below room temperature. Liquid fluorine at liquid nitrogen temperatures is more corrosive than the gas at room temperature. The metals that can be used with liquid fluorine are nickel and nickel alloys, stainless steels, aluminum, magnesium, mild steel, titanium, tantalum, and zirconium. Except for very special applications, the only organic materials that can be used with either liquid or gaseous fluorine are the fluorocarbons. Polytetrafluoroethylene is the best. Of the nonmetallic inorganic materials, alumina is very resistant. Glass, asbestos, and some cements may have limited uses, and carbon materials are not recommended for elevated temperatures. (auth)

Fabrication

579 AD-234885

Westinghouse Electric Corp. Research Labs., Pittsburgh.

RESEARCH AND DEVELOPMENT IN HIGH STRENGTH HEAT RESISTANT ALLOYS. Interim Report No. 8 for August 27 through October 26, 1959. L. L. France. Jan. 15, 1960. 10p. Contract NOas 58852-C.

Emphasis during the report period was on preparation of 5-lb ingots of the more promising compositions resulting from Phase I of the study. Ingots of molybdenum, molybdenum alloys, niobium, and niobium alloys were prepared, and low density pure tungsten electrodes were arc melted. Several pure tantalum consumable arc melts were also made. Alloys for Phase III are being prepared. (For preceding period see AD-229808.) (J.R.D.)

580 APAE-70

Alco Products, Inc., Schenectady, N. Y.

SM-2—FUEL ELEMENT WELDING DEVELOPMENT, TASK 5.0. R. L. Harris. Aug. 11, 1960. 59p. Contract AT(30-3)-326. OTS.

The fabrication of stainless-steel plate type fuel elements was investigated for the inert gas shielded tungsten-arc welding process with no filler addition and the resistance-projection welding process. The resistance-welded element proved unsatisfactory owing to a critical and unconventional weld joint design. Consistently acceptable results in weld penetration and soundness were obtained in tungsten-arc welded fuel elements. Fuel plate composition or material condition produced little effect on measurable distortion obtained from welding. (C.J.G.)

581 CARDE-TM-290/59

Canada. Armament Research and Development Establishment, Valcartier, Que.

HIGH-ENERGY RATE FORMING OF METALS. H. P. Tardif. Aug. 3, 1959. 30p.

Theories and techniques of explosive forming are reviewed. Types of materials and shapes formed, dimensional aspects, and metallurgical aspects are discussed. Hardening, welding, and pressing of powders by explosive energy are discussed. 98 references. (C.J.G.)

582 DP-430

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

FABRICATION OF URANIUM OXIDE FUEL ELEMENTS. G. Rolland Cole, Anthony S. Ferrara, and Harvard H. Kranzlein. Dec. 1959. 38p. Contract AT(07-2)-1. OTS.

The fabrication of UO_2 fuel elements clad in metallic sheaths by swaging, rolling, and coextrusion was investigated. The effects of the type of UO_2 and of the materials and dimensions of the sheath were investigated. Fused UO_2 swaged in stainless-steel tubing reached a maximum density of 93% of theoretical. (auth)

583 HW-60059

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

URANIUM COLD EXTRUSION. G. W. Riedeman. Apr. 21, 1959. Decl. Sept. 1, 1960. 20p. Contract W-31-109-Eng-52. OTS.

Fabrication of hollow uranium slugs by cold extrusion at 550 to 750°F is reported. Diameter control and reproducibility were excellent. Preferred orientation induced by this process was removed by a single standard β heat treatment. (C.J.G.)

584 LAMS-2434

Los Alamos Scientific Lab., N. Mex.

FABRICATION OF TANTALUM CAPSULES FOR LAMPRE I REACTOR. G. S. Hanks and J. M. Taub. June 10, 1960. 64p. Contract W-7405-eng-36. OTS.

Tantalum fabrication methods primarily for use as a container for molten plutonium are described. One method involved the rolling of a Ta billet into sheet of the desired gage, cutting a circular blank, and deep drawing the tantalum blank through successive stages into the desired shape. Another method used for the fabrication of Ta containers consisted of a combination of impact extrusion and ironing. This method involved the extrusion of the cast billet into rod, swaging the rod to a suitable diameter, and cutting it into slugs of the desired length. The slugs were then impact

extruded into heavy walled containers. These starting containers were then taken through successive dies where the wall thickness was ironed down to the desired gage. (auth)

585 NAA-SR-4762
Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
MELTING AND FORMING OF SER FUEL RODS. P. S. Drennan. Oct. 1, 1960. 30p. Contract AT-11-1-GEN-8. OTS.

Sixty-one metal alloy rods were fabricated for the SNAP Experimental Reactor (SER), a compact nuclear power source. These rods were 1 in. in diameter by 10 in. long and consisted of an alloy containing 7 wt. % highly enriched uranium and 93 wt. % zirconium. Melting of the alloy was done by generally accepted consumable-arc melting techniques. Extrusion of alloy slugs into rods was carried out, unclad, at 850°F. Suitable controls were developed to insure uniformity of products and reproducibility of batches. The procedures developed for this application are considered adequate for future requirements. (auth)

586 NMI-1216(p.17-48)
Nuclear Metals, Inc., Concord, Mass.
COLD WORKING OF URANIUM. P. Smoot.

Techniques for producing swaged and cold drawn uranium wire and tubing were investigated. Lubrication, annealing, maximum possible reduction through a single die, and maximum possible cold reduction were studied experimentally, using both dingot and ingot uranium. Extruded rods were swaged and then drawn in accordance with experimental die schedules. Extruded tubing was drawn in accordance with an experimental schedule of dies and plugs. Various lubricants were evaluated. Different annealing cycles were tried, and their effect on workability noted. In order to determine the maximum amount of cold work possible, certain specimens were cold worked until fracture occurred. Various reductions in a single drawing pass were tried in order to establish the maximum reduction possible. As a result of this work, techniques for producing cold-drawn wire and tubing were established. A mixture of Molykote and SAE 20 oil was found to be a satisfactory swaging lubricant. For drawing, Fluorolube and Steelskin provided effective lubrication if the surface of the metal was first oxidized. The best annealing cycle for dingot and ingot wire was found to be 5 minutes in vacuum at 1100°F. With this cycle approximately 70% cold reduction could be made without further annealing. Dingot and ingot wire could be reduced as much as 20% in a single drawing pass. (auth)

587 NMI-1216(p.66-77)
Nuclear Metals, Inc., Concord, Mass.
URANIUM MONOCARBIDE. P. D. Corzine.

Uranium and carbon compacts made up to stoichiometric uranium monocarbide weights were melted in crucibles made from beryllia, stabilized zirconia, tantalum, molybdenum, and thoria. In each case the molten charge reacted with the crucible material. One sound dense extrusion of uranium plus monocarbide powders was made. The conditions required to convert this rod to sound high-density uranium monocarbide were not established. (auth)

588 NMI-1216(p.78-99)
Nuclear Metals, Inc., Concord, Mass.
GLASS LUBRICATED EXTRUSION PROCESS. E. S. Guidoboni.

The comparatively new use of glass as a lubricant is investigated and compared to normal lubrication procedures in the extrusion of high-temperature materials. In repeated tests, glass proved superior in greatly reducing extrusion pressures, allowing faster ram speeds, providing better extruded surfaces, and increasing die and tool life. There were also indications of its effectiveness in reducing end shift, a characteristic problem in coextruded fuel elements. (auth)

589 NMI-1216(p.100-56)
Nuclear Metals, Inc., Concord, Mass.
CASTING OF THORIUM AND URANIUM ALLOYS. ARC MELTING. P. D. Corzine.

The arc melting of Th–U alloys in the range 5 to 10 wt. % thorium is described. Induction melting and casting investigations were carried out on 100 to 115-lb melts of 5 to 10 wt. % uranium, and 14-lb melts in the range of 5 to 25 wt. % uranium. Fifteen melts were made to determine the feasibility of casting Th–U alloy fuel slugs to size. A number of mold designs and mold washes were tried, as well as two crucible designs. It was concluded that such slugs can be cast directly in graphite-washed molds coated with simple slurries of any of three metallic oxides (thoria, beryllia, or zirconium). (W.D.M.)

590 NMI-1236
Nuclear Metals, Inc., Concord, Mass.
FABRICATION DEVELOPMENT OF BERYLLIUM-CLAD URANIUM-3.8% SILICON, URANIUM-10% MOLYBDENUM, AND URANIUM–URANIUM MONOCARBIDE CERMETS. J. Greenspan. Aug. 30, 1960. 71p. Contract AT(30-1)-1565. OTS.

Results of extrusion and roll cladding of U–Si, U–Mo, and U–UC cermets with beryllium are presented. Data are tabulated, and various diagrams and photographs of equipment and products are included. (J.R.D.)

591 NP-9137
Chromalloy Corp., White Plains, N. Y.
EXPLOSIVE FORMING OF REFRACTORY METALS. Bi-Monthly Report No. 5 [for] March 1, 1960 through April 30, 1960. Richard L. Wachtell. May 1, 1960. 41p. Contract NOas-59-6265-c.

Explosive-forming tests, employing 15% dynamite with the photo-grid technique, were performed on molybdenum and a molybdemum-titanium alloy to study material elongation. Strain rate and metal movement velocity were measured. Preliminary firings were made on niobium using RDX and 15% dynamite at 200, 400, and 600°F. (For preceding period see NP-8866.) (C.J.G.)

592 ORNL-2988(p.453-69)
Oak Ridge National Lab., Tenn.
WELDING AND BRAZING. G. M. Slaughter, R. G. Gilliland, et al.

The development programs carried out in the Welding and Brazing Laboratory are primarily project-connected and, consequently, vary quite widely in scope. The development of suitable joining techniques for unique and unusual materials of interest in reactor technology comprises a major effort. Beryllium-joining development was concentrated on high-temperature brazing, diffusion bonding, and fusion welding, and successful joints were produced by all three methods. Corrosion-resistant brazing alloys which readily flow on graphite were developed, and procedures were developed for successfully joining graphite to structural metals for high-temperature service. By the use of suitable gas-shielding procedures, contamination-free niobium welds can be made without the use of controlled-atmosphere chambers. The aging characteristics of Nb–1% Zr alloy welds were determined, and methods were developed for circumventing this condition. The use of a nickel-base alloy filler metal (BP-85) for joining ferritic steels to austenitic stainless steels was investigated and

successful welding procedures were developed. The impact behavior of various weld heat-affected zone microstructures in ASTM SA-212 pressure vessel steel is under study. Suitable procedures for fabricating fuel elements and other components of interest in the various reactor projects are also being developed. Techniques for fabricating the Experimental Gas-Cooled Reactor fuel element were developed and utilized successfully in a pilot-plant construction of 50 Title I fuel assemblies. The Arvac process was successfully developed for sealing advanced fuel capsules containing helium at less than atmospheric pressure. Suitable techniques were developed for the penetration of a multitude of thin-walled burst-slug detection tubes and small-diameter thermocouples through the EGCR pressure shell. The inert-gas consumable-electrode process was found to be a feasible means for remotely joining the EGCR experimental through tubes to the surrounding structure. Techniques were developed for fabricating compartmented flat-plate fuel elements and high-vacuum solidified-metal seals. Successful welding procedures were developed for fabricating prototype HFIR aluminum fuel elements with extremely close dimensional control. The electron-beam welding process was successfully used for constructing HFIR dynamic-corrosion test specimens within very tight tolerance limitations. (auth)

593 ORO-322

Clevite Corp. Mechanical Research Div., Cleveland.

FUEL BEARING FIBERGLAS IN ALUMINUM BASE FUEL ELEMENTS. Monthly Progress Letter No. 15 [for] August 1, 1960 to August 31, 1960. R. H. Baskey. Sept. 12, 1960. 3p. Contract AT(40-1)-2557. OTS.

Sixteen depleted uranium-bearing Fiberglas compacts were vacuum hot-pressed during the report period. These were cut for use as core sections. Each section was radiographed to determine the fiber distribution. Other experiments with these sections are described in which clad plates were fabricated by open rolling. High-strength alloys are being tested for Fiberglas core fabrication. Alclad high-strength alloys constrained core sections, thereby reducing the rippling effect to a minimum on the majority of plates. Results of experiments to determine optimum reduction rates are included. Results of dummy fuel plate evaluation are also included. (For preceding period see ORO-313.) (J.R.D.)

594 SCNC-258

Sylvania-Corning Nuclear Corp., Bayside, N. Y.

ADVANCED FABRICATION DEVELOPMENT OF STRUT-TYPE FUEL ELEMENTS. Joseph A. Ruzga. Dec. 19, 1958. Decl. June 9, 1960. 24p. Contract AT-30-1-GEN-366. OTS.

The aim of the work was to develop fabrication methods for individual component parts and assemblies of streamlined, strut type fuel elements, the struts consisting of a stainless-steel–UO_2 core with stainless-steel cladding. The work included providing facilities for making component parts, such as struts, top and bottom plates, side plates, and housings, to required dimensions and tolerances. Methods were investigated for the fabrication of complete fuel units on a quantity-production level. Fuel struts were cut to length and then end-closed by crimping or heat treating. Top and bottom plates were perforated and blanked to size, and side plates were blanked, embossed, and clipped to length. Housings were formed by spot welding top, bottom, and side plates together. Struts were assembled into housings, and this fuel unit was then placed into an outer housing to make a completely streamlined strut type fuel element. (auth)

595 TID-6492

Stevens Inst. of Tech., Hoboken, N. J. Powder Metallurgy Lab.

SLIP CASTING OF NUCLEAR FUEL ELEMENTS. Progress Letter No. 14 [for] July 1, 1960 through July 31, 1960. Gregory J. Comstock. Aug. 23, 1960. 7p. Contract AT(30-1)-2258. OTS.

Problems in casting and sintering stainless steel–UO_2 dispersion plate cores 15 in. long were investigated. Plaster molds gave satisfactory results in releasing cast plates when treated with DC20 silicone. Methods of supporting and covering green plates during sintering were investigated. (For preceding period see TID-6193.) (C.J.G.)

596 TID-6692

Denver. Univ. Denver Research Inst.

THE KINETICS OF TRANSFORMATION OF NIOBIUM-BASE, ZIRCONIUM ALLOYS. Monthly Letter Report No. 4 [for] August 1, 1960 to September 1, 1960. Charles E. Lundin. Sept. 9, 1960. 3p. Contract AT(11-1)-752. OTS.

Research devoted to developing methods for fabricating niobium-base zirconium alloys was continued. Samples prepared by rolling at 1000°C showed the effects of cracking, and data indicate that a higher temperature is required to roll ingots with a 14% or greater zirconium content. Characteristics of rolling clad ingots at 1150 and 1200°C are being studied. (For preceding period see TID-6061.) (J.R.D.)

597 WADC-TR-59-531

Battelle Memorial Inst., Columbus, Ohio.

DETERMINATION OF THE CAUSES OF WELD-METAL CRACKING IN HIGH-STRENGTH STEELS AND THE DEVELOPMENT OF HEAT-TREATABLE LOW-ALLOY-STEEL FILLER WIRES FOR USE WITH THE INERT-GAS-SHIELDED ARC-WELDING PROCESS. Period covered: June 16, 1958 to July 30, 1959. Herbert W. Mishler, Robert E. Monroe, and Perry J. Rieppel. Nov. 10, 1959. 60p. Project No. 7351. Contract AF33(616)-5878. OTS.

The causes of weld-metal-cracking in SAE 4340 steel were investigated. The development of filler wires for producing welds heat treatable to ultimate-tensile-strength levels greater than 225,000 psi was studied. Freezing-cycle hot-tension studies were made on various heats of SAE 4340 steel containing various sulfur and phosphorus contents. Results indicated that the combined sulfur and phosphorus contents of SAE 4340 steel should be kept below 0.025 wt. % to prevent weld-metal hot cracking. An intergranular phase believed to be associated with hot cracking was found during light and electron microscopy of high-phosphorus SAE 4340 steels. This phase was tentatively identified as the iron-iron phosphide euctectic. Two new restrained weld-metal-cracking tests were developed that will give a quantitative measure of weld-metal-cracking resistance. Filler wires were developed which can produce weld metals capable of being heat treated to various strength levels in the range of 225,000 to 280,000 psi ultimate tensile strength. (auth)

598

MATERIALS AND WELDING IN REACTOR CONSTRUCTION. [PART] II. R. Nass. Atomwirtschaft 5, 399-408 (1960) Sept. (In German)

In this second part of the article the welding methods that are used for the welding of materials for the different reactor constituents are described. The difference between the individual methods and their advantages and disadvantages are considered in some detail. 35 references. (tr-auth)

599
DISTRIBUTION OF PHOSPHORUS AND SULPHUR IN FULLY AUSTENITIC STAINLESS STEEL WELDS. S. M. Makin, C. B. Alcock, D. R. Arkell, and P. C. L. Pfeil (Atomic Energy Research Establishment, Harwell, Eng.). Brit. Welding J. 7, 595-9(1960) Oct.

Small additions of radioactive sulfur and phosphorus were made to a 24% Cr–21% Ni stainless steel, which was fabricated into thin sheet. Welds were examined by autoradiography and metallography. The concentration of phosphorus in the middle of the weld zone was measurably greater than in the original sheet. This concentration resulted from depletion of the first metal to solidify along the sides of the weld. Phosphorus was found to concentrate in the interdendritic regions of a casting of a basically similar steel. Phosphorus is important in the hot-cracking of fully austenitic stainless steel welds. Sulfur was not concentrated preferentially in the weld metal and it was concluded that sulfur is not important in the formation of cracks observed in these welds. (auth)

600
WELDING METALLURGY OF THE NIMONIC ALLOYS. J. Hinde and D. R. Thorneycroft (Mond Nickel Co. Ltd., [London]). Brit. Welding J. 7, 605-14(1960) Oct.

The constitution and physical properties of alloys of the Nimonic and Nimocast series are discussed in relation to their influence on welding characteristics. Effects of the solution and precipitation-hardening heat-treatments used to develop optimum high-temperature properties are correlated with the behavior of the respective materials under the thermal conditions imposed by welding. The mechanical properties of the parent metals and of the welded joints are described, with particular reference to the effects of the various temperatures attained by the weld itself and by adjacent heat-affected zones. Welding procedures are recommended for both wrought and cast nickel-base high-temperature alloys. Brazing techniques and materials are considered, including the possibility of combining the brazing operation with thermal hardening treatments required for certain alloys. (auth)

601
WELDING PROBLEMS ASSOCIATED WITH NUCLEAR FUEL ELEMENTS. A. F. Taylor (United Kingdom Atomic Energy Authority, Springfields, Eng.). Brit. Welding J. 7, 615-22(1960) Oct.

For operation at higher temperatures than is possible with magnesium alloys, stainless steel, or the less common materials such as beryllium, niobium, and zirconium must be considered. Problems associated with the development of welding techniques for sealing present and future elements to a stage where an automatic process can be used on a production scale are considered. The end seal is not the only application of welding in fuel element manufacture, as attachments and supports or the fuel itself demand welds of high integrity. (auth)

602
USE OF WELDING IN CHEMICAL PLANTS IN THE U.K.A.E.A. F. S. Dickinson and B. Watkins (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Brit. Welding J. 7, 643-51(1960) Oct.

General features of 18% Cr–13% Ni–Nb fully austenitic stainless steel, as widely used for chemical plants handling radioactive processing liquors, are discussed. Indications are given of the controls applied to ensure freedom from cracking, and methods of pipe branch connections are presented. A unique problem facing the designers of such a chemical plant is that of "criticality." This entails careful design to avoid chain reactions when highly enriched materials are involved, and the systems to safeguard against this hazard are treated. The difficulties encountered during the fabrication of components in Monel and Inconel are described; it appears that consistency of quality cannot be assured with the same certainty as with the stainless steels. For most of the vessels manual metal-arc methods were used, but for pipework and where access for welding from one side only prevailed argon-arc techniques with appropriate filler wires were essential. Metallurgical studies of some corrosion failures during the initial operation of a plant manufactured from nickel-bearing materials indicated that better corrosion resistance, for the particular service conditions, could be obtained when niobium was excluded from the weld metal. (auth)

603
COLUMBIUM AND TANTALUM FABRICATION. H. M. McCullough (Universal-Cyclops Steel Corp., Bridgeville, Penna.). p.160-8 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

Inasmuch as fabrication procedures are dependent to a large extent on raw material and the method of consolidation, a review is given of the processes of metal consolidation. The methods used to convert niobium and tantalum vacuum-melted ingots depend primarily upon purity, distribution of impurities, and ingot size. Pure-metal ingots with low interstitial elements are cold ductile. (B.O.G.)

604
REVIEW–THE FABRICATION OF TUNGSTEN. C. H. Toensing (Firth Sterling, Inc., Pittsburgh). p.183-94 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

The main factors limiting the extensive use of tungsten are its lack of oxidation resistance in air at high temperatures, its high density, and the problem of fabricating the consolidated metal. Notable progress is being made in these processes and especially in fabrication techniques. The review is divided into sections on properties, consolidation, and methods of working. Consolidation is accomplished by pressing and sintering, arc melting, electron beam melting, and slip casting. The methods of working tungsten are given as breakdown, forging, swaging, rod and sheet rolling, spinning, deep drawing, stamping, forming, machining, wire drawing, and joining. (B.O.G.)

605
PROCESS AND APPARATUS FOR THE HOT SHAPING OF METALS AND METAL ALLOYS. (to Deutsche Gold-und Silber-Scheidenstalt Vormals Roessler). British Patent 843,362. Aug. 4, 1960.

A method for shaping oxygen-sensitive metals, e.g., uranium, thorium, zirconium, and chromium, is described in which drawing and extruding processes are performed in a molten-salt medium. Two apparatus are designed, one for drawing in which the blank and die lie in a molten-salt bath just beneath the surface and the other for extrusion in which the article emerging from the die is bathed in molten salt. (D.L.C.)

606
IMPROVEMENTS RELATING TO RADIOACTIVE SOURCES. Pierre Vidal. British Patent 847,206. Sept. 7, 1960.

An arrangement of radiocobalt disks, other than stacking in the form of cylinders, consists of (1) housing the disks in holes in a stainless-steel plate, the disks and plate being of the same thickness (1 mm), and (2) enclosing the assembly in a stainless-steel envelope of 0.76 mm thickness. The advantage of such an arrangement over stacked disks is radiation economy. (D.L.C.)

607

IMPROVEMENTS IN OR RELATING TO THE SINTERING OF CERAMIC COMPACTS. John Edward Antill and Henry Lloyd (to United Kingdom Atomic Energy Authority). British Patent 848,571. Sept. 21, 1960.

A method is given for producing long sintered ceramic compacts and consists of passing a furnace along the length of an elongated ceramic article, whereby a sintering zone of short length passes through the compact. Necking resulting from contraction as the compact passes through the furnace does not result in cracking; hence tubes and rods of any length may be sintered in a small inexpensive furnace. For a given temperature and rate of furnace motion, the final density is reproducible. The advantages of this sintering method over methods in which the whole compact is contained in one furnace are many: more accurate temperature control, speed, extremely long lengths, simplified safety precautions in the case of toxic materials like beryllia, reduced deformation of the compacts, and low operational furnace costs. Three examples of the method are given for sintering alumina and magnesia at 1550 to 1700°C. (D.L.C.)

608

A PROCESS OF PRODUCING A URANIUM DIOXIDE MATERIAL. (to United States Atomic Energy Commission). British Patent 848,609. Sept. 21, 1960.

Sintered UO_2 bodies of high density can be made by mixing 1 to 5% (preferably 1.5%) of calcium hydride powder with UO_2 powder, compacting the mixture, heating in vacuum to above 675°C, and heating further to 1700 to 1900°C for 2 hr to sinter the mixture. Calcium hydride decomposes above 675°C, producing H_2 and calcium metal which provides a reducing atmosphere and creates vacancies in the lattice, resulting in higher density at sintering temperatures. The quantity of calcium hydride to be used depends on the amount of excess O_2 (above that corresponding to UO_2) present in the UO_2 powder. One experiment, using the above method, gave a sintered body of density 8.64 g/cm^3 as compared with a density of 7.79 g/cm^3 obtained for a body with no calcium hydride. (D.L.C.)

609

IRON COATINGS AND METHOD OF APPLYING. (to United Kingdom Atomic Energy Authority). British Patent 848,661. Sept. 21, 1960.

Iron coatings on uranium are superior to other coatings and may be prepared by etching the uranium and electroplating in a conventional iron electroplating bath containing, e.g., ferrous ammonium sulfate. The final coatings may have a thickness of from 1.5×10^{-5} to 10^{-3} in. and may be used as barrier coatings over which various protective coatings can be applied, e.g., lead, zinc, tin, and cadmium, because the iron prevents uranium from diffusing into these metals. The coatings are especially valuable for effecting aluminum alloy coatings of uranium, since aluminum reacts with uranium to form brittle and undesirable alloys. Two examples of iron coating of uranium rods followed by aluminum coating are given. (D.L.C.)

610

IMPROVEMENTS IN OR RELATING TO POROUS MEMBRANES AND METHODS OF MANUFACTURING SUCH MEMBRANES. (to Commissariat à l'Énergie Atomique). British Patent 849,837. Sept. 28, 1960.

Porous membranes for use as barriers for gaseous diffusion separation of uranium isotopes in the form of UF_6 and other uses may be prepared by coating a fabric of a corrosion-resistant metal (nickel or silver) with a paste of Teflon, fixing the paste on the fabric by pressing, and drying to remove coagulant from the paste. The Teflon paste is prepared by forming an emulsion of Teflon and adding a coagulant to transform the emulsion into a paste; the coagulant may be alcohol, cyclohexanol, acetone, or an aliphatic acid. The mechanical strength of the membrane, improved greatly by the fabric, may be increased still further by adding to the emulsion a filler of powdered nickel, CaF_2, or TiO_2. Several examples are given of the preparation of membranes with and without fillers and their permeabilities. The separation efficiencies of some of the prepared membranes were also measured using CO_2–N_2 mixtures. (D.L.C.)

611

IMPROVEMENTS IN OR RELATING TO METHODS OF MANUFACTURING GRAPHITE BODIES AND NUCLEAR FUEL MATERIALS COMPRISING SAID GRAPHITE BODIES. Jack Williams and David Thomas Livey (to United Kingdom Atomic Energy Authority). British Patent 850,016. Sept. 28, 1960.

High-density (≥1.9 g/cm^3) graphite bodies of reasonable strength may be prepared from pure graphite powder if the powder is first reduced to a very small particle size by grinding in a ball mill and then cold-compacted with pressures of 20 to 70 tons/in.^{2}. The grinding should be done in a ball mill containing porcelain or hardened-steel balls for >45 hr, or until 80% of the particles have a diameter <20 μ and no particles of diameter >40 μ are left. The compacting should be done with hydrostatic pressing rather than die pressing because of its greater efficiency and improved compact properties. This method can be used for preparing nuclear-fuel bodies by mixing powdered nuclear fuel (≤50 vol. %) with the graphite powder prior to compacting. Several examples of the preparation of graphite and nuclear-fuel bodies are given together with a particle-size analysis of graphite powder after grinding for various lengths of time up to 72 hr. (D.L.C.)

612

METHOD AND DEVICE FOR ARC WELDING. (to Commissariat à l'Énergie Atomique). British Patent 850,428. Oct. 5, 1960.

A method and device for arc welding in vacuum are described in which the arc is started by an electron source and an automatic means is provided for re-starting the arc in case of arc failure. Complete details of the circuitry are given. (D.L.C.)

Properties and Structure

613 ARF-2191-4

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

IMPROVED VANADIUM-BASE ALLOYS. Bimonthly Report No. 4 for June 1 to July 31, 1960. B. R. Rajala and R. J. Van Thyne. Aug. 30, 1960. 16p. Contract NOas 60-6056-c.

Promising V–Nb alloys are being investigated since they exhibit most of the properties desired in high-temperature materials. Fabrication of 0.050-in.-thick sheet was per-

formed by cold-rolling and hot-rolling techniques. Tensile testing was conducted at room temperature and 2000°F. Specimens were protected by a helium atmosphere at the elevated temperature. Short time stress-rupture properties were also determined for several alloys at 2000°F; the alloy V–5Ti–20Nb–0.25C lasted ~40 hr at a stress of 10,000 psi. Oxidation-resistant coatings were also studied. Zinc coatings provided protection for the V–5Ti–20Nb alloy at temperatures up to 1800°F. (auth)

614 BM-RI-5664

Bureau of Mines.

THERMODYNAMICS OF SOME OXIDES OF MOLYBDENUM AND TUNGSTEN. E. G. King, W. W. Weller, and A. U. Christensen. Mar. 1960. 32p.

Heat-capacity data leading to the evaluation of the 298.15°K entropies of WO_2, WO_3, MoO_2, and MoO_3 and the heat contents (above 298.15°K) of MoO_2, MoO_3, WO_2, and WO_3 are presented. Included are the heats of fusion of the two trioxides and the heats of formation at 298.15°K of the four oxides. (J.R.D.)

615 BMI-1029

Battelle Memorial Inst., Columbus, Ohio.

$MoSi_2$–UO_2 CERAMICS FOR HIGH-TEMPERATURE FUEL ELEMENTS. John R. Gambino, John F. Quirk, and Winston H. Duckworth. Aug. 18, 1955. Decl. Sept. 1, 1960. 30p. Contract W-7405-eng-92. OTS.

The strength and oxidation resistance of densely sintered $MoSi_2$ ceramics were not seriously impaired at temperatures by adding up to 30 wt. % of dispersed UO_2. Porosity and dispersion of the UO_2 particles had a critical effect on stability; best results were obtained with porous calcined UO_2 less than 40 μ in particle size. Further improvement was obtained by a brief preoxidation of sintered compacts in air. Bend strengths of the $MoSi_2$–30 wt. % UO_2 compositions remained above 26,900 psi at high temperatures. Room-temperature strengths of 37,000 to 42,000 psi were not reduced by rapid temperature cycling. Weight changes of specimens of the best composition were less than 0.1% after 100 hr. Pyroplastic deformation of $MoSi_2$–30 wt. % UO_2 specimens became a significant factor only at higher temperatures under a bending stress of 1000 psi. The values for modulus of elasticity determined at room temperature for $MoSi_2$ and $MoSi_2$–30 wt. % UO_2 were 50 and 39 $\times 10^6$ psi, respectively. Uranium migration in UO_2-bearing specimens thickly clad with sintered $MoSi_2$ was low (<0.002 in.) at high temperatures. (auth)

616 DMIC-137

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

DESIGN INFORMATION ON 17-7 PH STAINLESS STEEL FOR AIRCRAFT AND MISSILES. R. J. Favor, O. L. Deel, and W. P. Achbach. Sept. 23, 1960. 38p. Contract AF18 (600)-1375. (PB-151096). OTS.

A summary of design information pertinent to the use of 17-7 PH stainless steel in aircraft and missile applications is presented. Elevated-temperature design curves for short-time ultimate tensile strength, tensile yield strength, compressive yield strength, ultimate shear strength, bearing ultimate strength, and bearing yield strength are given. (auth)

617 DMIC-Memo-68

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

SOME PHYSICAL PROPERTIES OF MARTENSITIC STAINLESS STEELS. J. G. Hoag and D. B. Roach. Sept. 28, 1960. 32p. (PB-161218).

A summary of the physical-property data on the martensitic stainless steels is presented. (J.R.D.)

618 HW-63848

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

METALLOGRAPHIC OBSERVATIONS OF SWELLING IN URANIUM. Interim Report. T. K. Bierlein, B. Mastel, and R. D. Leggett. June 1, 1960. 59p. Contract AT (45-1)-1350. OTS.

The swelling of uranium was studied under irradiation temperatures of 200 to >800°C and over a burn-up range of 0.02 to 0.41 at. %. The specimens were subjected to preirradiation annealing for periods up to 100 hr at 600 to 880°C. Pore sizes in the samples varied from 200A to 100 μ in diameter. (C.J.G.)

619 IGR-TM/R-0175

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

A NOTE ON THE THERMAL CONDUCTIVITY OF UO_2. R. G. Rose. Mar. 1958. 3p.

A relation between thermal conductivity and temperature for use in estimating the temperature distributions in UO_2 fuel elements is proposed Data for use in calculation of center temperature and temperature distributions in UO_2 fuel elements are included. (J.R.D.)

620 NAA-SR-5319

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

MEASUREMENT OF SURFACE AREA OF URANIUM DIOXIDE POWDER AND SINTERED PELLETS. T. Smith. Oct. 1, 1960. 47p. Contract AT-11-1-GEN-8. OTS.

The surface areas of sintered uranium dioxide pellets (individual pellets ranging from 50 to 2000 cm^2) were measured with a precision of 1.3% and a reproducibility of about 4% with a BET adsorption apparatus, using krypton as the adsorbate. Powder samples (10 to 50 mg) of uranium dioxide, anatase, zirconia, and ceria were measured with a precision of 0.5% and a reproducibility of about 3%. An excellent correlation was found between the surface area and the average particle diameter, as measured with a Fisher Sub-Sieve Sizer. An equation, relating the surface area(S) and the average particle diameter(D) [$S = 1.67/D$, as compared to $S = 0.547/D$ (if the particles were spherical)] shows the powder has a shape factor of about 3. (auth)

621 NAA-SR-5537

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

PHASE TRANSFORMATION, TWINNING, AN ANELASTIC PHENOMENON ASSOCIATED WITH ZIRCONIUM HYDRIDE. Roger Chang. Sept. 15, 1960. 15p. Contract AT-11-1-GEN-8. OTS.

The atom movements and crystallography of cubic-to-tetragonal transformation in ZrH_2 are studied and discussed according to the phenomenological theories of Bowles and MacKenzie and of Wechsler, Lieberman, and Read. The large internal-friction peak found in $ZrH_{1.92}$ (but absent in $ZrH_{1.6}$) suggests that it is associated with a stress-induced twin interface motion. The relaxation phenomenon appears to be controlled by a diffusion process, presumably that of hydrogen, with an activation energy of about 20,000 cal/mole. (auth)

622 NMI-1216(p.56-65)

Nuclear Metals, Inc., Concord, Mass.

BETA-BERYLLIUM PHASE ALLOY PROGRAM. S. H. Gelles.

A program to investigate various beryllium alloy systems in the hope of finding one which will stabilize the high-temperature β phase to room temperature or to a temperature low enough to retain the β phase to room temperature by quenching is summarized. (W.D.M.)

623 NMI-1222
Nuclear Metals, Inc., Concord, Mass.
TEXTURE OF EXTRUDED ZIRCONIUM AND ZIRCALOY-2 TUBING. V. Nerses. July 11, 1960. 35p. Contract AT(30-1)-1565. OTS.

The textures developed in extruded thin-wall zirconium and Zircaloy-2 tubes were studied for materials with two different fabrication histories. The two primary fabrication methods used were extrusion cupping and rolling. In all cases, the textures were similar with the [10.0] poles parallel to the extrusion direction. The results of burst-strength tests, conducted on the extruded thin-wall tubes, and coextrusion experiments were also independent of the primary fabrication history. (auth)

624 NP-9242
Franklin Inst. Labs. for Research and Development, Philadelphia.
DEVELOP HIGH PURITY BERYLLIUM AND DETERMINE THE MECHANICAL PROPERTIES OF MATERIAL PRODUCED. Bi-monthly Progress Report [for] May 1 to June 30, 1960. Edward Hein, Marvin Herman, and Grant E. Spangler. 7p. Contract NOas 59-6242-c. (P-A2323-6).

An investigation is presented on the preparation of high-purity beryllium and on its deformation and fracture properties. The beryllium was prepared by zone refining of a beryllium rod, and a tensile test was performed on a single crystal of the zone-refined beryllium. (W.L.H.)

625 ORNL-2988(p.6-8)
Oak Ridge National Lab., Tenn.
DEFORMATION OF CRYSTALLINE SOLIDS. R. O. Williams.

Of the physical properties which are significantly altered by deformation, perhaps the one of greatest importance is the change in internal energy (stored energy) of the metal. This energy is intimately associated with the changes during deformation and with subsequent recovery and recrystallization on heating. Work is under way to measure this energy during deformation as the difference between the mechanical-energy input and the heat liberated. This heat is used to vaporize a fluid, and the volume of the resulting gas is measured, providing a measure of the heat. Some difficulties were encountered with the present design, but it is felt that those problems not already solved can be taken care of with minor changes. Results indicate that the method holds considerable promise. Immediate plans are to study copper, nickel, aluminum, zirconium, and brass from 24°C down to −190°C. (auth)

626 ORNL-2988(p.45-60)
Oak Ridge National Lab. Tenn.
MICROSTRESSES IN CRYSTALS. B. Borie, C. J. Sparks, and J. V. Cathcart.

A modification of an x-ray diffractometer for automatic diffuse-scattering measurements was planned and is now being carried out. Upon completion of the modification, the instrument will gather data by count-rate measurements at predetermined intervals in 2θ, rather than by continuous scanning. The data output will be in the form of a printed paper tape. As modified, the diffractometer will allow the measurement of diffuse scattering considerably more rapidly with no compromise of precision. Expressions for the various orders of temperature diffuse scattering (TDS) for cubic elements are developed which show that the diffuse peaks at the Bragg maxima are broader for the higher order TDS contributions and which also show that the average value of lth order TDS (in electron units per atom) is $f^2e^{-2M}(2M)^l/l!$. These results are shown to be strictly valid only in the case of the Debye lattice model. Their relevance to the Warren theory and the more recent Paskin theory for TDS for cubic powders is discussed, and it is shown that the Warren theory is more accurate. X-ray-diffraction line-broadening measurements of Cu_2O films grown on copper were interpreted in terms of strains induced in the films as they grow because of the coherence of the films with the substrate. It is expedient to consider the growth of the film to be in two stages. Probable differences in the structure of the films and their influence on the growth rate in the two stages are described and discussed. (auth)

627 ORNL-2988(p.85-96)
Oak Ridge National Lab., Tenn.
STRUCTURE OF METALS. C. J. McHargue, G. F. Boling, et al.

An x-ray study of stacking faults produced by deformation at 4.2°K showed a faulting frequency of the same order in ultrahigh-purity lead as in copper, silver, and gold. This behavior is contrary to that predicted by current theory regarding faulting. The addition of silver to lead had no effect on the faulting behavior, whereas 20 at. % indium completely suppressed fault formation. The ORNL method for preferred-orientation determination was used to show the texture in an Fe−3% Si sample. The results were compared with those obtained by the conventional pole-figure method. The several components deduced from the axis charts were shown to explain the magnetic-torque curve obtained for the same material, whereas the components deduced from pole figures were only in general agreement with the torque data. High-purity vanadium single crystals were found to deform by mechanical twinning when loaded in compression at 77°K. This concludes a study which showed that the group VA body-centered cubic metals readily twin when the interstitial impurity content is low and the grain size is large. (auth)

628 ORNL-2988(p.97-134)
Oak Ridge National Lab., Tenn.
THEORY OF ALLOYING. J. O. Betterton, Jr., G. D. Kneip, Jr., et al.

For zirconium alloys, the derivative with respect to solute concentration of the relative free energy of the α and β phases, the α-phase density of states, axial ratio, and electrical resistivity were found to be linearly proportional to the number of electrons in the solutes Ag, Cd, In, Sn, and Sb. A zero point or null effect of the solute occurs for the relative free energies at solute valence near two, but for density of states and axial ratios this occurs near zero solute valence. If one assumes that each of these properties depends on the position of the Fermi level, there is no clear resolution of the different effective zirconium valences indicated by these results. However, because the free energies are a more complicated property, the present preference is for nearly zero-valent zirconium. The rigid-band model and the assumption that the unfilled d band of zirconium does not extend into the Wigner-Seitz cells of the solute atoms permit the derivation of a relation between the change in the density of states and the solute concentration. The experimental curve for the solutes Ag, In, and Sn agrees with this relation and shows that the number of s type electrons in zirconium is small, that the band structure is probably overlapped, and that the density of states increases rapidly with increasing electron concentration. Measurements of the axial ratios of α-zirconium with additions of Ag, Cd, In, Sn, and Sb show that the change in the axial ratio is proportional to the product of the solute concentration and the valence. The proportionality to solute valence was found to be principally due to a similar dependence of the

c-lattice constant upon solute valence, suggesting a Brillouin zone interaction with the electron gas in the [001] direction in α-zirconium. The electrical-resistivity change per unit solute concentration at 4.2°K is increased by the solutes Ag, Cd, In, Sn, and Sb in proportion to their normal chemical valences. Norbury's rule was found not to be valid for these alloys. The large effect found even with the lowest-valence solute is associated with the filled d shell in each of these solutes and the discontinuities which would appear in the zirconium unfilled d band in such alloys. The dependence upon valence is probably due to the same mechanism proposed by Mott and Jones for nickel alloys. At higher temperatures negative deviations from Matthiessen's rule increase with alloy composition and temperature. At least some of this deviation appears to be related to an increase in the number of overlapping electrons. The integral free energy of formation of α and β solid solutions of Cd-Zr alloys was established by measurement of the cadmium vapor pressure over the alloys. Equations are given for the α/β phase boundaries in terms of the measured thermodynamic properties, and the phase boundaries of the Zr-Cd alloys are calculated numerically.

629 ORNL-2988 (p.135-45)
Oak Ridge National Lab., Tenn.
X-RAY DIFFRACTION. H. L. Yakel, Jr., R. M. Steele, et al.

Diffraction examinations of several rare-earth phosphides, nitrides, and antimonides were completed, and structures were determined. A structural investigation of a new class of compound $AMnO_3$, where A = Lu, Yb, Tm, Er, and Y, is nearing completion. Single crystals of a new compound $Sr_2Be_3O_5$ were obtained, and the structure of this phase is being studied. Aging transformations in quenched U–Nb, Ti–Nb, and Ti–Ta alloys are being studied by x-ray-diffraction techniques in an effort to understand the structures of intermediate phases and the nature of the transformations involving them. The investigation of the order-disorder transitions in nonstoichiometric Cu–Au alloys was extended by high-temperature-diffraction experiments with Cu–25 at. % Au and 37.5 at. % Au compositions. Intermediate ordered structures were not found at either gold content; the results at 37.5 at. % Au tended to support the commonly assumed phase diagram of the Cu–Au system. (auth)

630 ORNL-2988 (p.167-82)
Oak Ridge National Lab., Tenn.
ZIRCONIUM ALLOYS. M. L. Picklesimer, P. L. Rittenhouse, et al.

A continuing study of the transformation kinetics and products of the Zr-Nb-X alloy systems indicated that the vacancy concentration in retained β-Zr-15 Nb alloys strongly affects the nucleation rate and concentration of the metastable transition ω phase, an increased number of vacancies decreasing the incubation time for formation of ω phase. Preliminary studies of alloys of the zirconium-molybdenum system, using contents of 4 and 7.5 wt. % molybdenum, showed that metallography is of little aid in following the transformations, the principal changes being only the disappearance of a Widmanstätten platelet phase on aging to produce a clear grain structure similar to that reported previously for the zirconium-niobium alloy system. Hardness data for the β-quench and reheat transformation suggested that an age-hardening reaction had started at 500°C and below. Similar studies were started on the zirconium-copper alloy system, using 1.0 and 1.6 wt. % copper alloys. Metallography of transformed specimens did not show appreciable differences in the microstructures, regardless of time, temperature, transformation type (isothermal or β-quench and reheat), or composition. The microstructures of the β-quenched specimens showed a fine rectangular-block precipitate existing in a needle matrix. Hardness data for the isothermal transformation suggest that an age-hardening reaction occurs at 500°C and below, and that, if it occurs at temperatures above 500°C, the alloys over-age in less than 15 min. A study of the fabrication variables on the preferred orientation and anisotropy of mechanical properties of Zircaloy-2 was completed and reported in two topical reports. The principal conclusions were that small variations in the exact details of the fabrication procedure can appreciably affect the preferred orientation and anisotropy of mechanical properties produced and that the ORNL-HRP fabrication schedule for Zircaloy-2 used for several years produced the most isotropic material. A subsequent study of the resolved shear stress for several axis orientations for some of the fabrication schedules which produced material having a high degree of texture explained the high degree of tensile ductility observed in specimens whose tensile axes were along the c axis of the texture. Little strain occurred in the direction of the c axis when it was at 90° to the tensile axis. In tension along the c axis, twinning realigns slip systems favorably for deformation by slip. Compressive stresses, on the other hand, produce twinning such that little deformation by slip can occur, forcing most of the strain to occur by twinning, leading to cleavage and early fracture. A program of study of the effects of alloying elements and oxidizing environment on the oxidation rates and mechanisms for zirconium-base alloys was started. The initial study will be confined to oxidation in pure oxygen and in water. Oxidation equipment for the determination of the oxidation rates to a high degree of precision during the thin-film stage of oxidation was built and is undergoing tests. Duplicate runs for checks of reproducibility indicated that the equipment can produce the data desired but that several modifications must be made. Relatively large single crystals of zirconium-base alloys are needed in the oxidation study. Attempts to grow the desired single crystals as large grains in strip specimens are under way, using a steep thermal gradient moving along a specimen while the specimen is stressed by a constant load. Initial results show that grains as large as 5 mm in diameter were grown from grains 0.01 mm in diameter by 150 passes of the thermal gradient while the specimen was stressed at 1600 psi. The rate of growth of the large grains seems to be a function of the passage of the thermal gradient zone and not of the rate of passage. (auth)

631 ORNL-2988 (p.244-82)
Oak Ridge National Lab., Tenn.
MECHANICAL PROPERTIES. D. A. Douglas, Jr., W. R. Martin, et al.

The efforts of the Mechanical Properties Laboratory are in three general categories: (1) obtaining the necessary data for the solution of specific reactor-design problems, (2) studying the factors which control the flow and fracture of materials at elevated temperatures, and (3) developing new types of testing devices to accomplish tasks relevant to both of these programs. A new apparatus was constructed to permit the study of the geometrical relationship of UO_2 fuel pellets and the stainless-steel cylinder used to encapsulate the fuel. A radiographic technique was developed and used to reveal the relative expansion of the two materials under temperature gradients simulating service conditions. An extensometer working on the principle of

an air gage was developed; it is capable of measuring strains of 1×10^{-4}. Since the sensing device appears to be immune to irradiation effects, it may be particularly attractive for in-pile creep experiments. Two alloys recently developed by Haynes Stellite and the International Nickel Company were evaluated in the cast condition for service in the temperature range 1500 to 1700°F. Their creep strengths were superior to those of most of the alloys suitable for a reactor. Tube-burst tests and creep-buckling tests on type 304 stainless steel were continued to determine the behavior of this alloy under service conditions anticipated for the Experimental Gas-cooled Reactor. Creep properties in gases which may contaminate the helium coolant were conducted and no pronounced deleterious effects were noted. Irradiation tests were conducted on unstressed, heated coupons of beryllium to ascertain the magnitude of the problem of generation of helium in the lattice of the metal as a result of neutron bombardment. Contrary to predictions based on work by other investigators, the first experiment revealed an unexpected amount of swelling. Research on the flow and fracture of metals was continued with regard to dynamic loads, combined stresses, and environmental effects. Progress was reported in attempts to relate stress-strain parameters to fracture under cyclic loads. New test equipment permitted the combined stress work to be extended into new stress states. Results tend to confirm hypotheses that the maximum principal stress is the determining factor in elevated-temperature rupture. The analysis relating creep to combined stress states was applied to the case of a hexagonal metal, Zircaloy-2. The results of uniaxial creep tests for specimens of different texture orientations were interpreted in terms of the analytical model derived for face-centered-cubic metals. The data indicate that anisotropy reduces the strain for fracture in certain combinations of principal stresses and that this effect becomes more pronounced at elevated temperatures. Theories developed through mechanical-metallurgy research were applied to predicting the failure of dispersion type fuel elements. Good correlation was found between the analytical model proposed and actual operating experience of one type of fuel element. It was possible to describe the relative effects on fuel-element performance of the more important fuel-element parameters. Further evidence was obtained to show that relaxation tests are useful in estimating values for material constants used in empirical creep equations. A graphic solution is shown to be a simple and direct method of computation, and data are presented for type 304 stainless steel and Zircaloy-2. In environmental research, the specific effects of oxygen, nitrogen, and hydrogen were explored in relation to niobium. Small additions strengthened the metal; however, threshold values were found for each gas which severely embrittled niobium at room temperature. At elevated temperatures creep values were enhanced by oxygen and nitrogen, but hydrogen produced an acceleration in the plastic flow rate. (auth)

632 TID-6291

Cornell Univ., Ithaca, N. Y.

LOW TEMPERATURE INTERNAL FRICTION STUDIES IN MOLYBDENUM (thesis). René Emil De Batist. Sept. 1960. 54p. Contract AT(30-1)-2471. OTS.

The internal friction of polycrystalline molybdenum was investigated at 4 to 300°K at frequencies of 2.6 and 40 kc. The effect of cold working and relatively low-temperature annealing on the peak observed in cold-worked samples in the vicinity of 80°K was studied. An attempt was made to correlate these results with Seeger's theory of the Bordoni Peak, first observed in face-centered cubic metals, using recent modifications of this theory by Paré. Results of measurements on niobium were used to calculate values for the activation energy and the attempt frequency for the damping peak observed in the vicinity of 180°K at 40 kc. (auth)

633 TID-6445

Case Inst. of Tech., Cleveland.

TRANSFORMATION CHARACTERISTICS OF ZIRCONIUM-NIOBIUM ALLOYS. Interim Technical Report No. 3. D. J. Cometto, G. L. Houze, Jr., F. A. Hultgren, and R. F. Hehemann. July 31, 1960. 46p. Contract AT(11-1)-588. OTS.

High-temperature aging reactions in hypermonotectoid Nb–Zr alloys were found to be relatively complex and involve at least two and possibly three mechanisms. A cellular mode of decomposition was observed at temperatures both above and below the monotectoid temperature (610°C). This mode of decomposition appeared to reflect primarily the tendency of the system to segregate into niobium-rich and niobium-poor regions rather than a eutectoidal type of decomposition of β simultaneously supersaturated with respect to both α and β_{Nb}. Evidence for this is provided by the fact that direct precipitation of α from β competed with the cellular reaction at sufficiently low temperatures. Single crystal studies of the ω reaction confirmed conclusions that ω present in quenched 12% niobium alloys is supersaturated in niobium. The temperature at which this ω forms on quenching appeared to be near 300°C. The quenched ω is a highly imperfect structure and consists of thin platelets parallel to β (110) planes. Quenched ω can be interpreted as a highly faulted structure and preliminary results suggest that the degree of faulting increases with niobium content of the alloy. Changes that occur on aging of quenched ω reflect annealing out of stacking faults and adjustments of composition to the values demanded by metastable equilibrium of ω with β. Tempering of martensite in the 5% niobium alloy appeared to be a relatively simple process involving the precipitation of a niobium-rich β phase from supersaturated α. Substantial hardening accompanied this precipitation process. (auth)

634 TID-6691

Denver. Univ. Denver Research Inst.

STUDY OF FACTORS INFLUENCING DUCTILITY OF IRON–ALUMINUM ALLOYS. Monthly Letter Report No. 4. George Rauscher and Joseph F. Nachman. Sept. 9, 1960. 5p. Contract AT(11-1)-742. OTS.

Resistivity was studied as a function of time for isothermally annealed Al–Fe alloys (13.6- and 13.9-Alfenol). Stress-strain relationships were determined for Al–Fe alloys of nearly perfect Fe_3Al order, complete disorder, and intermediate degrees of order. (See also TID-6566.) (C.J.G.)

635 TID-6694

Denver. Univ. Denver Research Inst.

STUDY OF FACTORS INFLUENCING DUCTILITY OF IRON–ALUMINUM ALLOYS. Interim Report. George Rauscher, Frank C. Perkins, and Joseph F. Nachman. June 6, 1960. 56p. Contract AT(11-1)-742. OTS.

An analysis of the basic slip mechanism of several aluminum–iron alloys containing 8 to 16% aluminium indicated a crystallographic type slip on the {110} planes. The effects of order-disorder heat-treatment variables, scavenging additions, and processing procedures were investigated. Plastic flow and fracture mechanisms in aluminum–iron alloys were investigated as a function of aluminum content. The degree of atomic ordering in aluminum–iron alloys was studied by means of electrical

resistivity and x-ray measurements. (See also TID-5626.) (C.J.G.)

636 USNRDL-TR-433

Naval Radiological Defense Lab., San Francisco.

THERMAL PROPERTIES OF MOLYBDENUM BETWEEN 2700° AND 4000°R. R. L. Rudkin. June 20, 1960. 23p.

The thermal properties of molybdenum were measured at 2700 to 4000°R using a resistance-heated 10 mil wire suspended in a vacuum. The total hemispherical emittance was found to vary from 0.27 at 2700°R to 0.33 at 4000°R. The heat-capacity values were 0.08 (Btu lb_m^{-1} $°R^{-1}$) at 2700°R and 0.098 (Btu lb_m^{-1} $°R^{-1}$) at 4000°R. The thermal conductivity was linear over this temperature range, changing from 62 to 55 (Btu $hr^{-1}ft^{-1}$ $°R^{-1}$). The product of the thermal conductivity and the electrical resistivity divided by the absolute temperature was nearly constant and was about 10% higher than $\pi/3(k/2)^2$, the value predicted theoretically for metals. (auth)

637 WADC-TR-59-511

General Electric Co. [Aircraft Nuclear Propulsion Dept.], Evendale, Ohio.

GAS ATMOSPHERE EFFECTS ON MATERIALS. Period [covered]: April 1958 to April 1960. R. A. Baughman. June 1959. 231p. Project No. 3048. Contract AF33(616)-5667. OTS.

The effects of a 5% H_2-95% N_2 (70% water vapor saturated) gas atmosphere on the properties of structural materials were studied at temperatures up to 1950°F and stresses up to 45,000 psi. Parent material as well as welded and brazed joints were subjected to tensile, impact, and strain-aging tests. The high-temperature alloys investigated included A-286, L-605, X-40, R-41, Inco 702, and U-500; the low-temperature alloys included 302 SS, 316 SS, 6061, AlloAT, Be-Cu, R-41, and 17-7Ph. Fundamental mechanism and coating studies were conducted on Inco 702, which had proved the most sensitive to the gas environment. The high-temperature rupture strength of each alloy studied was shown to be reduced below the corresponding air atmosphere strength by the special gas. Low-temperature properties were shown to be independent of the environmental effects studied. The basic mechanism effecting the high temperature properties was not clearly determined. (auth)

638 WADC-TR-59-539

Cincinnati. Univ.

THE SYSTEM TITANIUM-ZIRCONIUM-OXYGEN. Final Report from November 1, 1956 to August 31, 1959. Michael Hoch, Robert L. Dean, Chung K. Hwu, and Samuel M. Wolosin. July 13, 1959. 79p. Project No. 7021. Contract AF33(616)-3881. (AD-232887). OTS.

The general shape of the 1450°C isotherm of the Ti-TiO-ZrO_2-Zr region was calculated from the surrounding binary phase diagrams. The phase boundaries were determined. At 1450°C the system showed a large body-centered cubic beta field, which extends from the two metal-oxygen binary systems as a Gaussian error function, and is stable up to 30 at. % oxygen when titanium and zirconium are present in equal amounts. At higher oxygen concentrations, the beta field was in equilibrium with tetragonal ZrO_2. The following four regions, with three solid phases, were found present: two hexagonal $\alpha + \beta$ + tetragonal ZrO_2, α + TiO + tetragonal ZrO_2, and TiO + tetragonal ZrO_2 + cubic ZrO_2. On cooling, the beta phase transformed into the alpha phase, going through the omega transition phase. The isotherm at 1500°C for the region TiO-TiO_2-ZrO_2 was obtained using x-ray diffraction. At 1500°C a large cubic ZrO_2 region was present, which deformed into the orthorhombic $TiZrO_4$ when the composition was close to the TiO_2-ZrO_2 binary. A very large two-phase field, TiO + cubic ZrO_2, was present. The following regions, with three solid phases in equilibrium, were found: TiO + Ti_2O_3 + cubic ZrO_2, Ti_2O_3 + Ti_3O_5 + cubic ZrO_2, Ti_3O_5 + TiO_2 + cubic ZrO_2 ($TiZrO_4$). These regions were relatively small. The activities of titanium and TiO in the α + TiO + tetragonal ZrO_2 and the two $\alpha + \beta$ + tetragonal ZrO_2 regions were measured using the Knudsen effusion method. In the α + TiO + tetragonal ZrO_2 region the activities of both titanium and TiO were the same, as in the Ti + TiO binary. In the two $\alpha + \beta$ + tetragonal ZrO_2 regions, the titanium activity was high, and the TiO activity very low, though all phases present contained at least 30 at. % oxygen. This indicated a short-range order in the solid phases, zirconium atoms being preferentially surrounded by oxygen. The solidus and liquidus surfaces were determined by observing samples suspended with a fine tungsten wire in a tungsten crucible, and heated in vacuum. Eighty-nine compositions were investigated: eight univariant points, seven ternary eutectic points, and one congruent melting point were found. Cubic ZrO_2 decomposed through a peritectic reaction into liquid + tetragonal ZrO_2. The oxidation of titanium-zirconium alloys was investigated. The presence of zirconium in titanium, and vice versa, decreased the oxidation resistance, and the alloys oxidized faster than the pure metals. (C.J.G.)

639 WADD-TR-60-53

California. Univ., Berkeley. Inst. of Engineering Research.

EFFECT OF TEMPERATURE ON THE CREEP OF POLYCRYSTALLINE ALUMINUM BY THE CROSS-SLIP MECHANISM. Period [covered]: April 1, 1959 to March 31, 1960. N. Jaffe and J. E. Dorn. Mar. 21, 1960. 21p. Project No. 7360. Contract AF33(616)-3860. OTS.

The apparent activation energy for creep of polycrystalline aluminum was determined at 273 to 350°K by the effect of small abrupt changes in temperature on the creep rate. A constant activation energy of 27,400 ± 1000 cal/mole was obtained over strains of 0.003 to 0.23, stresses ranging from 2250 to 6000 psi and strain rates varying from 0.1145×10^{-3} to 29.5×10^{-3} per minute. Metallographic studies and comparison with theory suggested that creep in this range is controlled by the rate of cross-slip of dislocations. Both x-ray diffraction analyses and room temperature tensile stress-strain data following precreep revealed that the substructure produced in this range by creep under a given stress depended only on the total creep strain being independent of the actual test temperature. (auth)

640 WAL-TR-832.1/1

RIAS. Div. of Martin Co., Baltimore.

I. THE FRACTURE BEHAVIOR OF MAGNESIUM OXIDE BI-CRYSTALS. II. THE EFFECT OF SURFACE CONDITION ON THE MECHANICAL PROPERTIES OF LITHIUM FLUORIDE CRYSTALS. Interim Technical Report A. R. C. Westwood. May 1960. 43p. DA Project No. 5B93-32-006. Contract DA-36-034-505-ORD-11-RD.

Metallographic studies on compressed bicrystals of MgO revealed cracks formed at the boundary by the cooperation of two slip bands which met at the boundary. Cracks associated with a single pile-up were not observed. A dislocation mechanism for crack formation at low strains is proposed. In other work a comparative study was made of the behavior of as-cleaved chemically polished and coated LiF crystals. Coatings affected all stages of the deformation process, in some cases causing stress drops and reducing the stress and strain to fracture by one-half. Metallographic evidence for the piling up of dislocations beneath

surface films is presented together with an explanation for the experimental results, which appear consistent with a barrier mechanism of work hardening. (auth)

641 WAPD-BT-19(p.75-81)
Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.
SOME EXPERIMENTS ON THE PERMEATION OF HYDROGEN THROUGH OXIDE FILMS ON ZIRCONIUM. S. Aronson.

Experiments were performed on the permeation of hydrogen through oxide films on zirconium plates and spheres in which the samples were first oxidized in 20 to 30 mm water vapor at 400°C and then exposed to 250 to 300 mm hydrogen at 400°C. The oxide films, acquired by the samples during their exposure to the water vapor, inhibited hydrogen absorption for several hours before localized surface attack began. A qualitative evaluation of the hydrogen permeation mechanism is given. (auth)

642 WAPD-BT-19(p.83-92)
Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.
SURFACE AREAS OF SINTERED UO_2 COMPACTS. S. Aronson, J. C. Clayton, J. E. Rulli, and T. R. Padden.

Surface area measurements were made on a number of sintered UO_2 compacts using gas adsorption techniques. The gases krypton, butane, and ethane were employed to cover a wide range of surface areas (0.5 to 0.002 m^2). The relationship of surface area to compact density, porosity, and surface treatment was studied. (auth)

643 AEC-tr-4107
HIGH SPEED METHOD OF CONTROLLING THERMAL EXPANSION OF MATERIALS. V. G. Bravinskii and E. G. Bravinskaya (Ye. G. Bravinskaia). Translated from Zavodskaya Lab. 25, 1336-8(1959). 4p. JCL or LC.

A high-speed method of dilatometric control was developed for the determination of thermal expansion of glass, ceramics, metals, and alloys. The thermal expansion is determined by the same instrument for those materials listed above. The resulting deviation of the coefficients of linear expansion from the standard values did not exceed 3×10^{-7} centigrades^{-1}. (W.L.H.)

644 AEC-tr-4202
ON THE VISCOSITY OF LIQUID METALS. (O Vyazkosti Zhidkikh Metallov). A. M. Korol'kov. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 5, 123-6(1959). 7p. OTS.

Data on the viscosity of several metals and relations between the magnitude of their kinetic viscosity and other physical properties are presented. It is concluded that atomic volume and the entropy value can be used in objective viscosity evaluation of metals. (J.R.D.)

645 JPRS-4031
INVESTIGATION OF THE NATURE OF THE MANGANOUS PHASE OF CERTAIN MAGNESIUM-BASE ALLOYS. (Issledovaniye Pripody Margantsovistoy Fazy Nekotorykh Splavov na Osnove Magniya). M. E. (Ye.) Drits, Z. A. Sviderskaya, and L. L. Rokhlin. Translated from Doklady Inst. Met. im. A. A. Baykova No. 5, 85-94(1960). 13p. OTS.

An anode-dissolving method was used to characterize phases in Mg-base alloys. The manganous component in Mg–Mn–Al–Ca, Mg–Mn–Al, Mg–Mn, and Mg–Mn–Ca alloys was investigated. Data and constitution diagrams are included. (J.R.D.)

646 JPRS-4036
EFFECT OF COLD WORKING ON THE PROPERTIES OF ALUMINUM–COPPER AND ALUMINUM–COPPER–MAGNESIUM ALLOYS AGED UNDER VARIOUS CONDITIONS. (Vliyaniye Kholodnoy Deformatsii na Svoystva Splavov Alyuminiy-med' i Alyuminiy-med'-magniy pri Raznykh Usloviyakh Stareniya). Z. A. Sviderskaya and A. A. Vashchenko. Translated from Doklady Inst. Met. im. A. A. Baykova No. 5, 95-9(1960). 8p. OTS.

The properties of aged alloys in the systems Al–Cu and Al–Cu–Mg at aging temperatures of 150, 175, and 200°C were studied. It was found that the degree of cold working under these conditions controls the strength properties. Artificial-aging temperature increases improve the strength characteristics, and cold deformation affects the acceleration of the secretion processes related to hardening phases from the solid aluminum solution. (J.R.D.)

647 JPRS-4038
FUSIBILITY DIAGRAM OF THE Ti–Cr–Mo SYSTEM. (Diagramma Plavkosti Sistemy Ti–Cr–Mo). N. B. Grum-Grzhimaylo and V. G. Gromova. Translated from Doklady Inst. Met. im. A. A. Baykova No. 5, 145-50(1960). 9p. OTS.

Characteristics of the Cr–Mo–Ti system were investigated. The effort was primarily devoted to a study of the interaction of components and construction of a constitution diagram. (J.R.D.)

648 JPRS-4044
PHASE DIAGRAM OF THE V–La SYSTEM. (Diagramma Sostoyaniya Sistemy V–La). E. M. Savitskii (Ye. M. Savitskiy), V. V. Baron, and Yu. B. Yefimov. Translated from Doklady Inst. Met. im. A. A. Baykova No. 5, 166-73 (1960). 14p. OTS.

A phase diagram based on results of lanthanum-vanadium alloy studies is presented. Data on microstructure and results of thermal, radiographic, microhardness, and compression plasticity analyses were used as basis for the diagram. (J.R.D.)

649 JPRS-5179(p.1-17)
CONSTITUTIONAL DIAGRAM OF ZIRCONIUM–NIOBIUM. Yu. F. Bychkov, A. N. Rozanov, and D. M. Skorov. Translated from Met. i Metalloved. Chistykh Metallov, No. 1, 179-91(1959).

Studies of zirconium–niobium state diagrams are compared with the results obtained by other workers, and the properties of these alloys are examined. Alloy preparation and study methods are discussed. Results are presented graphically and by microstructural photographs. (J.R.D.)

650 JPRS-5179(p.28-44)
APPLICATION OF THE RADIOACTIVE ISOTOPE C^{14} FOR STUDYING ELECTROLYTIC TRANSFER OF CARBON IN METALS AND ALLOYS. Yu. F. Babikova and P. L. Gruzin. Translated from Met. i Metalloved. Chistykh Metallov No. 1, 200-12(1959).

A radiometric method for studying electrodiffusion of carbon in alloys is described. Concentration curves for electrodiffusion are plotted according to data on radioactivity for separate areas of the sample. Examples are included in which the radiometric method was used to indicate carbon transfer in iron and nickel under the influence of electric fields. (J.R.D.)

651 NP-tr-475
DEFORMATION AND THE ROLE OF THE TEMPERATURE FACTOR IN THE PROCESS OF CUTTING OF TITANIUM ALLOYS. A. D. Chubarov and N. N. Novikov. Translated from Vestnik Mashinostroeniya 39, No. 9, 55-9(1959). 12p. OTS.

A study was conducted to compare the hardening of

titanium alloys with the strain hardening of alloys based on nickel and iron in relation to the cutting parameters in various machining techniques and to determine the characteristics of hardening in the layer under the machined surface during alloy cutting. Resulting data are tabulated and discussed. (J.R.D.)

652 SCL-T-319

TESTING OF FOAM MATERIALS, DETERMINATION OF THE VOLUMETRIC WEIGHT. GERMAN INDUSTRIAL STANDARDS: DIN 53 420. (Prüfung von Schaumstoffen, Bestimmung der Rohdichte. Deutsche Industrie-Norm: DIN 53 420). Translated by Marcel I. Weinreich (Sandia Corp.). 5p. JCL.

Procedures are given for determining the volumetric density of foam materials. In general, it can be determined using either the entire test piece or a portion of it. (D.L.C.)

653 SCL-T-320

TESTING OF HARD FOAM MATERIALS, BENDING TEST. GERMAN INDUSTRIAL STANDARDS: DIN 53 423. (Prüfung von Harten Schaumstoffen, Biegeversuch. Deutsche Industrie-Norm: DIN 53 423). Translated by Marcel I. Weinreich (Sandia Corp.). 6p. JCL.

Procedures are given for the bending test of hard foam materials. The nomenclature, dimensions of the test body, testing apparatus arrangement, and evaluation methods are given. Some of the difficulties of testing foam materials are discussed. (D.L.C.)

654 SCL-T-321

TESTING OF SOFT ELASTIC FOAM MATERIALS, DETERMINATION OF THE PRESSURE-DEFORMATION RESIDUE AFTER A CONSTANT DEFORMATION. GERMAN INDUSTRIAL STANDARDS: DIN 53 572. (Prüfung von Weichelastischen Schaumstoffen, Bestimmung des Druck-Verformungsrestes nach Konstanter Verformung. Deutsche Industrie-Norm: DIN 53 572). Translated by Marcel I. Weinreich (Sandia Corp.). 6p. JCL.

Procedures are given for determining the pressure-deformation residue in soft elastic foam materials under constant deformation. This quantity should give an indication of the pressure sensitivity of foam materials. (D.L.C.)

655 SCL-T-322

TESTING OF HARD FOAM MATERIALS, SHEARING TEST. GERMAN INDUSTRIAL STANDARDS: DIN 53 422. (Prüfung von Harten Schaumstoffen, Scherversuch. Deutsche Industrie-Norm: 53 422). Translated by Marcel I. Weinreich (Sandia Corp.) from Kunststoffe 47, 31-2(1957). 4p. JCL.

Procedures are given for the shear testing of hard foam materials. (D.L.C.)

656 SCL-T-323

TESTING OF SOFT ELASTIC FOAM MATERIALS, TENSILE TEST. GERMAN INDUSTRIAL STANDARDS: DIN 53 571. (Prüfung von Weichelastischen Schaumstoffen, Zugversuch. Deutsche Industrie-Norm: DIN 53 571). Translated by Marcel I. Weinreich (Sandia Corp.). 6p. JCL.

Procedures are given for the tensile testing of soft elastic foam materials. (D.L.C.)

657 SCL-T-324

TESTING OF HARD FOAM MATERIALS, PRESSURE TEST. GERMAN INDUSTRIAL STANDARDS: DIN 53 421. (Prüfung von Harten Schaumstoffen, Druckversuch. Deutsche Industrie-Norm: DIN 53 421). Translated by Marcel I. Weinreich (Sandia Corp.). 6p. JCL.

Procedures are given for pressure testing hard foam materials. Such tests can distinguish hard-viscous and brittle-hard foam materials. (D.L.C.)

658 SCL-T-327

TESTING OF SOFT ELASTIC FOAM MATERIALS, CONTINUED-TEARING TEST. GERMAN INDUSTRIAL STANDARDS: DIN 53 575. (Prüfung von Weichelastischen Schaumstoffen, Weiterreissversuch. Deutsche Industrie-Norm: 53 575). Translated by Marcel I. Weinreich (Sandia Corp.). 5p. JCL.

A method for evaluating the resistance against further tearing of soft-elastic foam materials that had previously been cut or carved into is presented. (C.J.G.)

659

THE ATOMIC POSITION PARAMETER IN ALPHA URANIUM. Edward F. Sturcken (E. I. du Pont de Nemours & Co., Aiken, S. C.) and Ben Post. Acta Cryst. 13, 852 (1960) Oct. 10. (In English)

A precise value of $\underline{y}$, the variable positional parameter in the α-uranium structure, was obtained by a single crystal diffractometric technique for which the absorption is constant (i.e., independent of the Bragg angle). The parameter was determined by locating the minimum in plots of $\underline{R}$ (the discrepancy factor) as a function of assumed values of $\underline{y}$ at 0.1000 to 0.1050. A preliminary analysis indicated that the correct value was close to 0.1025. Plots of $\underline{R}$ as a function of $\underline{y}$ revealed a minimum of $\underline{y}$ at 0.1024 and 0.10275 at which point $\underline{R}$ was 1.5 and 3.8%, respectively. The best value of $\underline{y}$ was taken to be 0.1025 ± 0.0003, where the limits of error are for the 95% confidence interval of the mean. This is compared to the value of 0.105 ± 0.005 obtained by Jacob and Warren. (B.O.G.)

660

EFFECT OF HYDROGEN ON STABILITY OF MICRO CRACKS IN IRON AND STEEL. F. Garofalo (U. S. Steel Corp., Monroeville, Penna.), Y. T. Chou, and V. Ambegaokar. Acta Met. 8, 504-12(1960) Aug.

Evidence is available which indicates that hydrogen embrittlement and propagation of internal cracks in iron and steel are promoted by hydrogen gas in voids or micro cracks which may be formed by plastic deformation. It seems likely that these micro cracks originate from a dislocation pile-up as suggested by Stroh. As shown by Stroh, a stable micro crack can exist in a metal until a critical external stress is reached when the micro crack becomes self-propagating. For this condition, it is found that the Stroh relation is analogous to the Griffith and Cottrell relations and differs from these by a constant factor. As shown here, a Stroh crack ceases to be stable when a critical internal pressure is reached in the absence of an external stress. It is shown that in iron and steel, the amount of hydrogen needed to reach the critical pressure is within the range found experimentally for extensive internal cracking. The stability of a micro crack is considered for the condition of an imposed external stress and internal pressure. It is predicted, as observed experimentally by others, that pronounced hydrogen embrittlement of iron or steel may be caused by as little as 2 cm^3 of hydrogen per 100 g of metal (approximately 2 ppm). (auth)

661

THE ω-PHASE IN ZIRCONIUM BASE ALLOYS. B. A. Hatt and J. A. Roberts (Fulmer Research Inst. Ltd., Stoke Poges, Bucks, Eng.). Acta Met. 8, 575-84(1960) Aug.

The metastable ω-phase in zirconium base alloys was found to be truly hexagonal with $c/a = 0.622 \pm 0.002$. The orientation relationships with respect to the parent β-phase (b.c.c.) are: $(0001)_\omega \parallel (111)_\beta$ and $(2\bar{1}\bar{1}0)_\omega \parallel (\bar{1}01)_\beta$. The interpretation of x-ray data from high solute content alloys quenched from the β-phase indicates that the ω formed during quenching is heavily faulted. The ω structure is

designated diffuse ω. A model for the $\beta \rightarrow \omega$ transformation which satisfactorily accounts for the observed diffraction effects is developed. This is based on the gliding of $\{112\}_\beta$ planes in $(111)_\beta$ directions in a distinct sequence. The magnitude of the glide component is realistically altered to account for intensity differences in the diffractions from diffuse ω and bulk ω. (auth)

662

LOW-TEMPERATURE STRESS-RELAXATION PEAKS IN PLASTICALLY DEFORMED POLYCRYSTALLINE NIOBIUM. R. H. Chambers and J. Schultz (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Acta Met. 8, 585-7(1960) Aug.

Observations of stress-relaxation absorption peaks at low temperatures are related for a plastically deformed b.c.c. metal. Acoustic energy absorption peaks for frequencies in the tens of kilocycles were observed at 10 and 165°K in plastically deformed, polycrystalline niobium. Measurements of internal friction were made at 4 to 300°K by a resonant-bar technique in which alternating longitudinal stress at 10 to 100 kc/sec was employed. The use of electromagnetic transducers permitted measurements at strain amplitudes of 10^{-6} to 10^{-4}. (B.O.G.)

663

THE $Al_2O_3-Sm_2O_3$ AND $Al_2O_3-Gd_2O_3$ SYSTEM. S. G. Tresvyatskii, V. I. Kushakovskii, and V. S. Belevantsev. Atomnaya Energ. 9, 219-20(1960) Sept. (In Russian)

The solidus and liquidus temperatures for $Al_2O_3-Sm_2O_3$ and $Al_2O_3-Gd_2O_3$ were determined in the temperature range 1700 to 2350°C. Specimens containing up to 99.5 wt. % of the basic component were used. Thermal analysis of the heats of formation indicated (from Al_2O_3 side) that the melting point for $Al_2O_3-Sm_2O_3$ is 1770 ± 20°C. The eutectic for the rare-earth oxide side in $Al_2O_3-Sm_2O_3$ is at 1860 ± 20°C and for $Al_2O_3-Gd_2O_3$ is at 1930 ± 20°C. Compounds of $SmAlO_3$ and $GdAlO_3$ melt without decomposition at 2060 ± 20°C. The microstructure of the systems indicated eutectics at rare-earth oxide contents between 20 to 25 mole % (low melting point eutectic) and 70 to 75 mole % (high melting point eutectic). (R.V.J.)

664

DEVELOPMENT OF WROUGHT COBALT-TUNGSTEN-BASE ALLOYS. E. F. Adkins, D. N. Williams, and R. I. Jaffee (Battelle Memorial Inst., Columbus, Ohio). Cobalt No. 8, 16-29(1960) Sept. (In English)

Sykes showed that cobalt alloys containing up to 35% tungsten were subject to precipitation hardening, and developed sintered alloys containing 20 to 35% tungsten for use as swaging dies for hot-working tungsten. The cobalt-35 tungsten alloy develops a maximum hardness of 770 Brinell (Rockwell C 65) after solution treating at 1400°C and aging at 600°C. The alloy thus treated results as one of the hardest non-ferrous alloys known, being comparable in this respect with the high-speed steels. Further investigations indicated that binary cobalt-tungsten alloys could be hot-rolled at 1200 and 1300°C, although some difficulty would be encountered in fabricating alloys of high tungsten content. A program was initiated which comprised the development of fabrication and heat-treatment techniques for binary alloys for tungsten content to 35%. The effect of additions on selected binaries was investigated. The results reported indicate that cobalt-tungsten alloys present attractive properties that may lead to applications in two widely differing areas: as a superior high-temperature structural alloy and as a high-hardness tool alloy. (B.O.G.)

665

INVESTIGATION OF THE CHROMIUM ALLOYING PROCESS BY MEANS OF THE ISOTOPE DILUTION ANALYSIS. József Fodor, László Szőke, Tibor József, and Klára Mihics (Csepel Steel and Metal Works, Budapest). Energia és Atomtech. 13, 377-9(1960) Aug. (In Hungarian)

The dissolution of chromium during the alloying of steels with ferrochrome was investigated by using Cr^{51} as tracer, in order to establish the effect of particle size and of other parameters on the homogeneity of the finished alloy steel. As only a relative knowledge of the chromium distribution was required, the infinitely thick slab method was used. After employing different fabrication processes, such as introducing the ferrochrome at the bottom of the vessel containing 50 tons of molten metal, or using half-filled vessels, and determining the activity of the samples drawn from different locations by means of a scintillation counter, it was established that the chromium distribution was quite uniform. The conclusion was reached that such batch-alloying of low carbon steels is feasible because movement of the molten metal assures proper mixing. The isotope dilution analysis can be employed only if the heat content of the system is not changed noticeably during the alloying process. (TTT)

666

CONTRIBUTION TO THE STUDY OF THE STRUCTURE OF METALLIC URANIUM. A. Bassi and C. Corsetti (Centro Informazioni Studi Esperienze, Milan). Energia nucleare (Milan) 7, 638-48(1960) Sept. (In English)

Commercially pure uranium shows two polygonization phenomena which are a consequence of two allotropic transformations, $\gamma \rightarrow \beta$ and $\beta \rightarrow \alpha$. The results of the research carried out and the hypotheses on the nature of the subgrain boundaries are reported. The variations that one observes in the sub-structures brought about by the phase transformations under load and by thermal treatments are also described. (auth)

667

THIN-WALLED FUEL CANS MAY SAVE NEUTRONS. J. P. Ellington (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Engineering 190, 360-1(1960) Sept. 9.

Thin-walled collapsible nuclear fuel cans offer excellent neutron economy, but are not used because of the difficulty in predicting performance. Several possible modes of failure are discussed. Preliminary work indicated that, providing the can is elastic and the clearance between can and fuel is fairly small, any increase in pressure would force the can onto the fuel. If the pressure was further increased the portions of the can in contact with the fuel would be subjected to increasing forces, become unstable, and spring out. It is also possible that the can would be forced onto the fuel and a complex longitudinal wrinkle formed. Following the initial elastic deformation, creep deformations could occur exaggerating the initial deformed shape. Under cyclic power conditions, the thermal dilations of the fuel would provide either a clearance into which the can could collapse or an internal force restoring the can to its original dimensions. Fuel expansions could promote fatigue failure. Fuel temperatures are dependent on the gap, if any, between can and fuel, or on the interface pressure if contact exists. Therefore a knowledge of can and fuel is necessary if the behavior of a fuel element is to be predicted. (M.C.G.)

668

ON A COMPLEX RECRYSTALLIZATION TEXTURE IN 3% SILICON IRON. C. G. Dunn (General Electric Research

Lab., Schenectady, N. Y.) and C. J. McHargue. J. Appl. Phys. 31, 1767-70(1960) Oct.

Components in a complex primary recrystallization texture, which is a matrix texture for secondary recrystallization to the Goss texture in 3% silicon-iron strip, were determined by the axis-chart method of Jetter, McHargue, and Williams. The results obtained were compared with former pole-figure results and found to include components not previously resolved or noted. It is found also that the components of the texture explain reasonably well the observed magnetic torque curve of the material. (auth)

669

SOLUTIONS OF METALS IN MOLTEN SALTS. Daniel Cubicciotti (Stanford Research Inst., Menlo Park, Calif.). J. Chem. Educ. 37, 540-4(1960) Oct.

Many metals will dissolve to a large extent in their molten halides, and conversely the metals will dissolve some of their halides. Among the metal-salt systems showing large mutual miscibility are the alkali metal halides. Bredig et al., studied the sodium-, potassium-, and cesium-halide systems. The phase diagrams for the fluorides in this study are illustrated. The salient features of the system are: above a certain temperature the metal and salt are completely miscible and form a homogeneous liquid; very little metal dissolves in the solid salt; and usually, there is a region in which two immiscible liquids are found. The findings of other scientists in metal-salt systems are discussed. (B.O.G.)

670

CONDUCTION ELECTRONS IN SODIUM TUNGSTEN BRONZE. Joseph M. Keller (Ames Lab., Ames, Iowa.) J. Chem. Phys. 33, 232(1960) July.

The vanishing of the Knight shift of Na^{23} in sodium–tungsten bronze is interpreted in terms of an inverted conduction band. (auth)

671

COLUMBIUM METALLURGY ... A REPORT ON THE LAKE GEORGE MEETING. B. S. Shabel (Knolls Atomic Power Lab., Schenectady, N. Y.). J. Metals 12, 703-5 (1960) Sept.

A summary is given of papers presented at the AIME Symposium on Niobium Metallurgy held at Lake George, New York. The symposium was devoted to various aspects of fabrication; mechanical properties; aspects of niobium metallurgy from thermodynamic measurements to mechanical properties of binary alloys; and oxidation and corrosion. The highlights of 30 papers are included. (B.O.G.)

672

BERYLLIUM RESEARCH IN MISSILE DEVELOPMENT. Clayton O. Matthews (Lockheed Aircraft Corp., Palo Alto, Calif.). J. Metals 12, 780-5(1960) Oct.

Beryllium is inherently brittle, but its brittleness can be decreased by controlling the grain size, texture, composition, heat treatment, and other factors. A comparison is given of the weights of beryllium and conventional aircraft materials required for a multi-web fin structure under load; this comparison shows that beryllium is superior on a weight basis. However, until more test data are collected, it is not known whether or not beryllium will qualify as material for more complex configurations. The beryllium research program at Lockheed Missiles and Space Division is briefly described. Beryllium ingots of good quality were produced by electron-beam melting, and data on their properties are given. The need for a method for analyzing beryllium for oxygen contents less than 200 ppm is filled by γ-activation analysis techniques that can determine oxygen (10 to 5,000 ppm), carbon (100 to 25,000 ppm), and nitrogen. In the absence of interfering impurities, these oxygen and carbon ranges can be lowered still further. The effects of alloying on cast beryllium stuctures were studied with particular reference to controlling the solidification process to produce a fine-grained, equiaxed structure with improved properties. The kinetics of beryllium corrosion in air were studied above 850°C, and an Arrhenius plot gives activation energies of 1.1×10^5 and 1.06×10^4 cal/mole in the ranges 930 to 1065°C and 1056 to 1295°C, respectively. The electric resistivity of beryllium was also studied. It appears to be a function of metallic impurity content but not of nonmetallic or total impurity content, and it varies greatly from lot to lot in the range 100 to 700°C. An extensive testing program was conducted on the mechanical properties of beryllium in the form of hot-pressed blocks, cross-rolled sheets, etc., and the data will be collated in a book. The methods for evaluating surface damage by machining operations are discussed. For joining purposes mechanical joints and silver brazing are satisfactory, and electron-beam welding was shown to be feasible with commercial beryllium. It is concluded that the primary problem in beryllium usage is ductility and associated properties; possible methods for solving this problem are discussed (e.g., by dispersion microstructures). (D.L.C.)

673

RECENT ADVANCES IN BERYLLIUM METALLURGY. S. H. Gelles, J. J. Pickett, and A. Wolff (Nuclear Metals, Inc., Concord, Mass.). J. Metals 12, 789-92(1960) Oct.

Research on beryllium at Nuclear Metals, Inc., is described with particular reference to the problem of producing a more ductile crystal structure than the hexagonal close-packed structure normally found at room temperature and to the problem of discovering the cause of brittleness. Attempts were made to stabilize the bcc phase, which is inherently more ductile than the hexagonal close-packed phase, to temperatures lower than 1250°C by alloying. Partial success was attained in that the Ni-Be system was found to contain a bcc phase (beta) with an eutectic of ~1070°C at ~8 at. % nickel, but attempts to stabilize this phase by quenching beryllium-8 at. % nickel from ~1200°C were unsuccessful. The question of the effects of impurities on mechanical properties is next considered, and affirmative evidence for such effects is found in aging processes followed by electric resistivity measurements. Extruded beryllium rods were quenched and aged at temperatures between 200 and 1000°C, and resistivity vs. time data were collected. Large changes in resistivity were observed, especially at 600°C, indicating that precipitation processes are taking place; such processes are slow at 200 to 400°C, fast at 600 and 800°C, and do not appear at 1000°C. Similar experiments were made and followed by mechanical strength tests, and the results again indicate impurity effects. The precipitation processes may explain the ductility decrease in the range 400 to 600°C. (D.L.C.)

674

LATTICE SPACINGS IN THORIUM–YTTRIUM ALLOYS. D. S. Evans and G. V. Raynor (Univ. of Birmingham, Eng.). J. Nuclear Materials 2, 209-15(1960) Sept. (In English)

Using all the precautions found to be necessary in previous work on the lattice spacings of very reactive alloy systems, the spacings for the face-centered cubic and close-packed hexagonal solid solutions based, respectively, on thorium and yttrium were measured at 25°C, following annealing at 750°C. The lattice spacings observed for yttrium were a = 3.6441, c = 5.7358 kX. Solution of thorium in-

creases the c-spacing and decreases the a-spacing. The lattice spacing of thorium is very slightly affected by the solution of yttrium. From the results of lattice-spacing measurements, and from those of a metallographic examination, the two-phase region between the cubic and hexagonal solid solutions extends from 49 to 69 at. % yttrium. This is in conflict with the work of previous investigators (Eash and Carlson), and reasons for the discrepancy are discussed in terms of the effects of impurity on the relative stabilities of the two structures. (auth)

675

EFFECTS OF HYDROGEN ON THE TENSILE RUPTURE CHARACTERISTICS OF STAINLESS STEEL. R. Blanchard, J. Pelissier, and M. Pluchery (Centre d'Etudes Nucléaires, Grenoble, France). J. Nuclear Materials 2, 216-24(1960) Sept. (In French)

Considerations are given for the effects of hydrogen on stainless steel. Apparent ultimate tensile strength is only 80% of the initial value for a hydrogen content of about 50 cc NTP/100 g, and reduction in area decreases from 80 to 55%. A special two-stage replica technique was developed which allows fracture surfaces of small tensile specimens (about 0.3 mm diameter) to be examined by electron microscopy. All the specimens showed evidence of ductile character throughout the range of hydrogen contents investigated, but the aspect of the fracture surface gradually changes with increasing hydrogen content. (auth)

676

THE PLASTIC DEFORMATION OF ALPHA-URANIUM. A. G. Young, K. M. Gardiner, and W. B. Rotsey (English Electric Co. Ltd., Whetstone, Leics., Eng.). J. Nuclear Materials 2, 234-47(1960) Sept. (In English)

Experiments on the plastic behavior of magnesium-reduced alpha-uranium above 300°C are reported. The first part describes the results of uniaxial creep tests under isothermal conditions and presents a relation between secondary creep rate, stress, and temperature which applies at 450 to 650°C. The second part describes the effects of thermal cycles on the plastic deformation under load. Experimental results are given, and a theory is developed to relate the plastic deformation to the applied stress and the amplitude of the cycle. (auth)

677

PROPOSED NOMENCLATURE FOR PHASES IN URANIUM ALLOYS. J. Lehmann (Centre d'Etudes Nucléaires, Saclay, France) and R. F. Hills. J. Nuclear Materials 2, 261-8(1960) Sept. (In French and English)

Since the Mo–U system was first investigated, an extensive fund of information has accumulated which is confusing because of the diversity of terminology. A meeting was held at Saclay between representatives associated with the metallurgy of uranium alloys to agree upon a nomenclature for the phases in uranium alloys. Although the proposed nomenclature has special reference to Mo–U alloys, it is believed to be sufficiently general to cover the equilibrium and metastable phases in all uranium systems showing solubility in the body-centered cubic γ-phase. (B.O.G.)

678

VARIATION WITH TEMPERATURE OF YOUNG'S MODULUS OF POLYCRYSTALLINE GRAPHITE. I. B. Mason and R. H. Knibbs (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature 188, 33-5(1960) Oct. 1.

Measurements of Young's modulus of polycrystalline artificial graphite from 20 to 1000°C indicated that the variation with temperature is not always positive. There was a well-defined minimum in the region of 200°C. The temperature at which the minima occurred was not constant but appeared to lie between 100 and 300°C, depending on the nature of the material. The occurrence of the minimum and the subsequent rise of the modulus may be attributed to some structural change that becomes important at about 200°C. Several theories are advanced to account for this variation. (M.C.G.)

679

CRYSTALLIZATION OF AMORPHOUS NIOBIUM OXIDE DURING ANODIC OXIDATION. D. M. Lakhiani and L. L. Shreir (Battersea Coll. of Tech., London). Nature 188, 49-50(1960) Oct. 1.

During a study of anodic oxidation of niobium in a variety of electrolytes, it was observed that temperature and current density had a marked influence on the anodizing characteristics. The v-t curve was rectilinear up to 190v at 25°C, but at higher temperatures the curve was characterized by a plateau. As the temperature became higher, the plateau became lower. Electron diffraction studies of films formed at various voltages at 25 and 90°C showed that at the lower temperature the oxide surface remained amorphous, but at 90°C and above the voltage-time plateau the structure corresponded to crystalline Nb_2O_5. (M.C.G.)

680

PLUTONIUM. Mieczysław Taube. Nowa Tech. No. 16, 200p.(1958). (In Polish)

Chapters are included on plutonium, the synthetic element; nuclear properties; chemical properties; physiological effects of plutonium; laboratory practices; plutonium as a nuclear fuel; role of plutonium in the development of nuclear energy; chemical technology of plutonium; and plutonium as an explosive material. (TTT)

681

SPECIFIC HEAT OF THORIUM AT HIGH TEMPERATURES. Duane C. Wallace (Ames Lab., Ames, Iowa). Phys. Rev. 120, 84-8(1960) Oct. 1.

The specific heat and electrical resistivity of high-purity thorium were measured from room temperature to 1000°C. The specific heat was measured by an electrical pulse-heating method. The results were analyzed in terms of additive lattice and electronic specific heats. (auth)

682

THEORY OF VACANCY ANNEALING IN IMPURE METALS. A. C. Damask and G. J. Dienes (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 120, 99-104(1960) Oct. 1.

The general equations for the annealing of vacancies in metals containing impurities to which the vacancies can be attached were solved on an analog computer for a wide variety of parameters. The computer results show that some simplifying assumptions may be made which permit the general equations to be solved analytically. It is shown that for many physically interesting cases of vacancy migration the decay curve is exponential, and the decay constant is related to, but not equal to, the rate constant for vacancy migration. It is further shown that only experiments performed on zone-refined metals can give the correct vacancy migration energy, and that impurity contents as low as 10^{-5} can seriously affect the results. Experimental methods and calculations are discussed which can be used to measure the binding energy of vacancies to impurities in metals prepared by controlled doping. (auth)

683

CONTRIBUTION ON THE TECHNOLOGY OF ALLOYING OF NIOBIUM WITH MOLYBDENUM AND TUNGSTEN. H. Braun (Metallwerk Plansee, Reutte, Tyrol, Austria),

K. Sedlatschek, and B. F. Kieffer. Planseeber. Pulvermet. 8, 58-65(1960) Aug. (In German)

The alloying behavior of niobium with molybdenum and tungsten and methods used in the fabrication of niobium–molybdenum and niobium–tungsten alloys are described. A number of mechanical, electrical, and chemical properties of primarily arc-cast niobium–tungsten alloys were examined from 0 to 100% niobium. (auth)

684

CONTRIBUTION ON THE STRUCTURE OF ZIRCONIUM–CARBON AND HAFNIUM–CARBON SYSTEMS. F. Benesovsky and E. Rudy (Metallwerk Plansee, Reutte, Tyrol, Austria). Planseeber. Pulvermet. 8, 66-71(1960) Aug. (In German)

The homogeneity range of ZrC and of HfC was determined by x-ray means by using hot-pressed samples prepared from zirconium, hafnium, and carbon. At 1400°, the ZrC is homogeneous from 35 to 50 at. % carbon; at 1550°, HfC is homogeneous from 37 to 50 at. % carbon. Micrographs substantiate these results. Tentative constitutional diagrams for the systems Zr–C and Hf–C are proposed on the basis of earlier work and this investigation. (auth)

685

ON THE ELECTRICAL CONDUCTIVITY OF HIGH-MELTING, HARDENED CARBIDES AND CARBIDE MIXED-CRYSTALS. E. Rudy and F. Benesovsky (Metallwerk Plansee, Reutte, Tyrol, Austria). Planseeber. Pulvermet. 8, 72-82(1960) Aug. (In German)

The electrical conductivity of carbides and carbide mixed-crystals of metals of the 4a, 5a, and 6a groups in the periodic system was determined with the use of an eddy-current method. The obtained resistivity values from the single carbides lay, for the most part, lower than the old as well as new values given in the literature. When a continuous mixed-crystal formation in the pseudobinary systems was present, more or less marked maxima in the resistance curve appeared. (auth)

686

THE OXIDATION OF HOT-PRESSED TITANIUM CARBIDE AND TITANIUM BORIDE IN THE TEMPERATURE RANGE 300°–1000°C. N. F. MacDonald (British Aluminium Co. Ltd., Stoke-on-Trent, Staffs, Eng.) and C. E. Ranlsey. Powder Met. No. 3, 172-6(1959).

The oxidation characteristics of pure hot-pressed titanium carbide and titanium boride (TiB_2) were studied in the range 300 to 1000°C. Titanium carbide shows a very marked peak in the rate of oxidation at ~450°C, the oxidation product at this temperature being anatase (TiO_2), which is powdery and non-adherent; the oxidation thus follows a linear law. Above ~700°C the rate increases rapidly and is approximately parabolic. The scale in this case consists of a dense crystalline film of rutile. The oxidation of the boride is less rapid than that of the carbide over the whole temperature range but it, too, shows a slight peak at 450°C. The oxidation tends to be parabolic at higher temperatures. The nature of the oxidation products was not determined. (auth)

687

THEORY OF X-RAY SCATTERING BY MULTICOMPONENT ORDERED SOLUTIONS. M. A. Krivoglaz and E. A. Tikhonova (Inst. of Physics of Metals, Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur. 5, 158-73(1960) Mar.-Apr. (In Ukrainian)

The authors discuss x-ray scattering by multicomponent-partially ordered solid solutions. Formulas are derived expressing the intensity of diffuse scattering through concentration of components on various kinds of lattice points and the correlation parameters, or derivatives, of the second order of the thermodynamic potential in respect to concentrations. Crystals of the β-brass type and crystals in which one sublattice is occupied by similar atoms and the other contains two kinds of atoms are considered in greater detail. Formulas are presented for the determination of intensity reduction factors in crystals of the NaKCl type. (auth)

688

THEORY OF X-RAY SCATTERING BY INTERSTITIAL SOLID SOLUTIONS. M. A. Krivoglaz and E. A. Tikhonova (Inst. of Physics of Metals, Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur. 5, 174-89(1960) Mar.-Apr. (In Ukrainian)

General formulas are derived for the intensity of diffuse scattering of x rays by interstitial solid solutions. It was shown that near the points of the reciprocal lattice the intensity of scattering may be expressed by derivatives of the lattice parameters of concentration, modulus of elasticity, and thermodynamic magnitudes, which may be determined from independent experiments. A more detailed consideration is given to solutions in which the interstitial atoms are in the octahedral interstices of face-centered and body-centered cubic lattices, and to solutions of the martensite type. The properties of the form of isodiffusive surface in a reciprocal lattice were studied for various structures. The displacements of atoms around the interstitial atom of carbon in the α-iron are calculated, as well as the average quadratic displacements. (auth)

689

ON INTENSITY OF X-RAY REFLECTIONS. V. M. Danilenko and G. Y. Kozyrskii (Inst. of Physics of Metals, Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur. 5, 190-202(1960) Mar.-Apr. (In Ukrainian)

The intensity of x-ray reflections from a single grain was investigated for the case of monochromatic radiation. The width of spots on the Debye circle was calculated on the assumption that increase in width was owing to the following factors: the divergence of the beam, the size of the grain, and the misorientation of coherent blocks. Formulas are given for the widths of reflections from a rotating crystal, with a moving and an immobile plate. (auth)

690

ON THE THEORY OF X-RAY SCATTERING BY ORDERED ALLOYS. V. M. Danilenko (Inst. of Physics of Metals, Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur. 5, 203-11(1960) Mar.-Apr. (In Ukrainian)

A theoretical investigation was made of x-ray scattering by ordered alloys with domain structure of ordering. For the case of completely ordered alloys with the composition AB, formulas were developed for the intensity and form of Bragg reflections. In the presence of domain structure the superstructural reflections became wider, with the width of the reflections being the reciprocal of the average value of the domain dimensions. In the case of a one-dimensional system of domain boundaries, the broadening took place in a direction perpendicular to the boundary planes. Three-dimensional domains involved three-dimensional broadening. (auth)

691

EFFECT OF THE COMPOSITION ON THE ELASTIC PROPERTIES OF BINARY NICKEL ALLOYS. T. Ya. Benieva (Inst. of Metal Physics, Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur. 5, 223-30(1960) Mar.-Apr. (In Ukrainian)

The effect of the composition on the elastic properties of

a number of systems with a nickel base (nickel–chromium; nickel–molybdenum; nickel–titanium; nickel–aluminum) was studied. The coefficients of thermal expansion of the investigated nickel alloys were determined. It was found that on adding chromium or molybdenum to nickel the modulus of elasticity increased, while on alloying with titanium or aluminum the modulus of elasticity was only slightly altered. The Debye temperature for nickel-chromium, nickel-titanium, and nickel-aluminum alloys was determined by Young's modulus data. The Debye temperature, calculated from elasticity constants, changed slightly on alloying. It was established that the ratio of the temperature coefficient of thermal expansion to the temperature coefficient of the modulus of elasticity for nickel-molybdenum and nickel-titanium alloys in a definite temperature region is approximately constant. Hence the temperature coefficient of the modulus of elasticity may be approximately determined by the thermal expansion coefficient of the alloy. (auth)

692

TEMPERATURE DEPENDENCE OF YOUNG'S MODULUS AND THE DAMPING DECREMENT OF NICHROME ALLOYS WITH ADMIXTURES OF TUNGSTEN OR MOLYBDENUM. Z. L. Khodov and V. I. Il'chenko (Inst. of Physics of Metals, Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur. 5, 235-41(1960) Mar.-Apr. (In Ukrainian)

The effect of molybdenum and tungsten admixtures on Young's modulus and the internal friction of nichrome was investigated. The temperature dependence of these magnitudes was also studied. It was found that for nickel–chromium–tungsten alloys, an increase in the tungsten concentration from 0.6 to 2.86 at. % led to an increase in the modulus throughout a temperature range of 20 to 800°C. The value of the damping decrement of these alloys changed very slightly in the range from room temperature to 500 to 550°C. On further rise in temperature there was a very sharp increase in the decrement. Of the investigated alloys of the nickel–chromium–tungsten system, containing from 0.97 to 6.44 at. % of molybdenum, the alloy with 6.44 at. % of molybdenum had the least value of Young's modulus. The nature of the temperature dependence of the damping decrement for nickel–chromium–molybdenum alloys is similar to that obtained for nickel–chromium–tungsten alloys. The sharp rise in the value of the decrement, observed at a definite temperature for each alloy, is probably associated with viscous slipping along the grain boundaries. The dependence of the modulus on the molybdenum or tungsten concentration obtained in this research furnishes grounds for the assumption that molybdenum and tungsten admixtures have a similar effect on nickel–chromium alloys (at any rate, in the case of a slight admixture of the third element (up to 3 at. %)). This is evidently owing to the fact, that these metals belong to one and the same subgroup of the Mendeleyev system. (auth)

693

DETERMINATION OF THE HEATS OF SUBLIMATION OF METALS BY ANOMALOUS DISPERSITY MEASUREMENTS WITH THE AID OF ROZHDESTVENSKII'S METHOD. THE THERMODYNAMIC PROPERTIES AND HEATS OF SUBLIMATION OF GALLIUM, INDIUM AND THALLIUM. L. V. Gurvich (Inst. of Mineral Fuels, Academy of Sciences, USSR). Zhur. Fiz. Khim. 34, 1691-8(1960) Aug. (In Russian)

It was shown that presenting the results of measurements of Nf by Rozhdestvenskii's method in the form of $R\ln Nf/T = A - B/T$, the heats of sublimation of metals at 0°K may be determined if the thermodynamic properties of the metals in the condensed and gaseous states are known. This procedure was applied in determining the heats of sublimation of gallium, indium, and thallium on the basis of published data for Nf. It was found that $\Delta H^0_0(Ga_{gas}) = 59.0 \pm 1.0$ kcal/gram atom, $\Delta H^0_0(In_{gas}) = 57.7 \pm 0.6$ kcal/gram atom and $\Delta H^0_0(Tl_{gas}) = 43.15 \pm 0.25$ kcal/gram atom. The thermodynamic functions of metals in the gaseous state were calculated by statistical methods, in the solid and liquid state on the basis of known values of heat capacities. (auth)

694

THERMODYNAMIC PROPERTIES OF ALLOYS OF THE SYSTEM CHROMIUM–TANTALUM. G. O. Piloyan, A. M. Evseev, and Ya. I. Gerasimov (Moscow State Univ.). Zhur. Fiz. Khim. 34, 1768-72(1960) Aug. (In Russian)

The thermodynamic properties of alloys of the Cr–Ta system were investigated at 1228 to 1303°C. The existence of the intermediate phase $TaCr_2$ was confirmed. (auth)

695

PHYSICAL AND CHEMICAL PROPERTIES OF TITANIUM–VANADIUM–NIOBIUM. I. I. Kornilov and V. S. Vlasov. Zhur. Neorg. Khim. 5, 2017-24(1960) Sept. (In Russian)

The electroconductivity, thermal expansion, and hardness of Ti–Nb and Ti–V–Nb were studied and constitution diagrams were prepared. (R.V.J.)

696

DATA ON FUSION IN Ti–Cr–B SYSTEMS. N. V. Cherkashina, N. A. Nedumov, and F. L. Shamrai. Zhur. Neorg. Khim. 5, 2025-31(1960) Sept. (In Russian)

An analysis was made of the microstructure and microhardness of compressed specimens of Cr–TiB_2 and Cr–Ti_2B. Ti_2B diffusion in chromium, after cooling at the rate of 20 to 40°C per min, is about 0.5 at. %, and the microhardness of the maximum Ti_2B solid solution in chromium is 200 kg/mm^2. TiB_2 diffusion in chromium is less than 2%, while the microhardness of the maximum solid solution in chromium is 220 kg/mm^2. The eutectic point is reached with 20 at. % Ti_2B or TiB_2. Additional Ti_2B or TiB_2 saturates the structure with boride phase producing a variable microhardness of 1300 to 2070 kg/mm^2, depending on the boron content. Results of thermal analyses are plotted and tentative melting point diagrams are developed. (R.V.J.)

697

ANALYSIS OF ALUMINUM–NICKEL DIFFUSION COUPLES BY X-RAY ABSORPTION. Paul Lublin (Sylvania Research Labs., Bayside, N. Y.). p.1-10 of "Advances in X-Ray Analysis. Volume 3." William M. Mueller, ed. New York, Plenum Press, 1960.

The x-ray technique for analyzing diffusion couples employs a monochromatic x-ray beam that impinges on a very fine slit, a holder for aligning the diffusion zone with the slit, and a scintillation counter for the high counting rates that are to be measured. Sample preparation, experimental instrumentation, and the application of the technique to the aluminum–nickel systems are discussed. (auth)

698

PRECISION X-RAY STRESS ANALYSIS OF URANIUM AND ZIRCONIUM. B. J. Wooden, E. C. House, and R. E. Ogilvie (Massachusetts Inst. of Tech., Cambridge). p.331-6 of "Advances in X-Ray Analysis. Volume 3." William M. Mueller, ed. New York, Plenum Press, 1960.

The feasibility of using x-ray diffraction methods to measure residual stresses in uranium and zirconium (Zircaloy-2) was investigated. A precision method was developed for the determination of diffraction peak positions and the precision associated therewith. The sta-

tistical tables of Fisher and Yates were used to determine what order polynomial provided the best least squares fit within the known precision of the observed data. It was found that a second-order polynomial provided an adequate regression. With the aid of a desk calculator less than 5 min calculation time is required to determine the peak position to a precision of ±0.01°. The stress constant for uranium was determined to be 1308 ± 110 psi/0.01° shift in $\Delta 2\theta$ for copper radiation on the (116) planes at $2\theta = 158.3°$. The stress constant for Zircaloy-2 was determined to be 430 ± 1 psi/0.01° shift in $\Delta 2\theta$ for chromium radiation on the (10.4) planes at $2\theta = 156.4°$. (auth)

699

A HIGH-TEMPERATURE STUDY OF PHASE PRECIPITATION IN SUPERALLOYS. John F. Radavich (Purdue Univ., Lafayette, Ind.). p.365-75 of "Advances in X-Ray Analysis. Volume 3." William M. Mueller, ed. New York, Plenum Press, 1960.

Many of the iron- and nickel-base superalloys exhibit brittle properties on heat-treatment, welding, or other fabrication processes at temperatures of about 2000°F or higher. Studies were carried out by means of electron microscopy, electron diffraction, x-ray diffraction, and x-ray fluorescence analysis of the precipitation in the metal and in an isolated form. Results of the electron microscope study of the surface of the metal show a grain boundary constituent to be present which increases in amount as the temperature is increased. Studies on the isolated residue of such samples show a very thin "featherlike" film to be located at the grain boundaries and enclosing the grains. Electron diffraction, x-ray diffraction, and x-ray fluorescence analysis studies of the thin films indicate that they are a TiC phase with very little alloying elements in solution. At temperatures above 2000°F the thin film becomes quite thick and tends to force the grains apart. It is believed that this form of the TiC phase promotes the severe embrittling nature of these alloys at high temperatures. Suitable heat-treatment at lower temperatures causes the TiC film to agglomerate and the grain boundaries to become "tight"; thus a more ductile condition results. (auth)

700

UNIVERSAL HIGH-TEMPERATURE TESTING MACHINE FOR VACUUM OR CONTROLLED ATMOSPHERE. M. J. Manjoine, L. L. France, and R. T. Begley (Westinghouse Research Labs., Pittsburgh). p.3-11 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

A versatile testing machine is described in which design considerations were dictated by the need for accurate elevated temperature test data obtained under controlled environmental conditions. The simplicity and rapidity of the testing cycle were considered. A minimum of two constant strain-rate tests of 100% per hr can be achieved in an 8-hr period. This is owing to ease of assembly and disassembly and to the rapid pumping cycle from atmospheric pressure to below 5×10^{-4} mm of mercury. The rigid control of the test environment is emphasized. (auth)

701

MECHANICAL PROPERTIES OF MOLYBDENUM AND MOLYBDENUM-BASE ALLOY SHEET. M. Semchyshen and Robert Q. Barr (Climax Molybdenum Co. of Michigan, Detroit). p.12-35 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

A summary is presented of several investigations of the mechanical properties of unalloyed molybdenum and of molybdenum-base alloys, processed to $\frac{1}{16}$-in.-thick sheet from vacuum arc-cast ingots. Unalloyed molybdenum displayed hardnesses of 240 to 266 DPH in the as-rolled state, and ultimate recrystallization temperatures were from 2100 to 2300°F. Bending transition temperatures varied significantly, and were generally lower for stress-relieved than for recrystallized specimens. The bending properties of both alloyed and unalloyed Mo sheet were improved by surface conditioning treatments. Recrystallization temperatures were essentially similar to wrought bar stock of similar composition, while tensile strengths and elongation values tend to be lower. A similar relationship was observed for creep-rupture strengths. Increasing the carbon content tended to decrease the ductility in tension. (B.O.G.)

702

HIGH-TEMPERATURE MECHANICAL PROPERTIES OF TANTALUM. F. C. Holden (Battelle Memorial Inst., Columbus, Ohio), F. R. Schwartzberg, and R. I. Jaffee. p.36-55 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

Recrystallization, tensile, and creep-rupture behavior of high-purity tantalum and two interstitial-containing tantalum alloys were determined. After a 75% cold reduction, tantalum was completely recrystallized on annealing 1 hr at 1200°C; this temperature was increased slightly by adding 560 ppm oxygen. Tensile properties to 500°C were determined. It was shown that the influence of interstitials in causing discontinuous yielding could be correlated with diffusivities. The moderate (25,000 to 32,000 psi) tensile strength of unalloyed tantalum can be increased by cold working and by minor additions of interstitials. The creep resistance of tantalum is increased by interstitial additions at short times and moderate temperatures, but is relatively unaffected at higher temperatures and longer times. Cold work remains effective in strengthening tantalum to 750°C. (auth)

703

EFFECT OF OXYGEN AND NITROGEN ON WORKABILITY AND MECHANICAL PROPERTIES OF COLUMBIUM. R. T. Begley and L. L. France (Westinghouse Research Labs., Pittsburgh). p.56-67 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

The effectiveness of vacuum levitation melting in reducing the oxygen and nitrogen content of niobium to extremely low levels is illustrated. Vacuum levitation can also be applied to the removal of volatile impurities from many other elements. At present, levitation melting is limited to the preparation of rather small specimens, about 10 to 20 g in weight. Niobium exhibits the ability to tolerate the presence of significant amounts of oxygen and nitrogen without detrimental effects on workability. Workability data obtained on small specimens cannot be directly applied to large commercial size ingots where large differences in grain size, cooling rate, homogeneity, and purity, with respect to other contaminants, exist. The data are useful in establishing the relative effects of various impurities. A

relatively low ductile-brittle transition temperature range and good cold workability are characteristic of the group VB elements vanadium, niobium, and tantalum. The ductility of these elements is not greatly affected by the presence of rather high interstitial impurity contents. The data presented illustrate that the tolerance range for interstitial impurities is rather broad for niobium. In the group VIB elements (chromium, molybdenum, and tungsten) very small variations in the oxygen and nitrogen level produce abrupt changes in the ductile-brittle transition range. More work is required to define completely the effects of specific interstitial elements on the ductile-to-brittle transition behavior of niobium. (auth)

704

EFFECT OF PURITY AND MANUFACTURING VARIABLES ON ELEVATED TEMPERATURE PROPERTIES OF BERYLLIUM. W. W. Beaver, R. G. O'Rourke, and J. N. Hurd (Brush Beryllium Co., Cleveland). p.81-94 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

The tensile, compressive, and shear properties of beryllium at 800 to 1500°F for various strain rates are evaluated for beryllium of different grain sizes, fabrication characteristics, and oxide contents. Enhanced elevated temperature properties through grain boundary distribution of beryllium oxide in beryllium metal are shown, and the effects of grain size and crystal anisotropy at elevated temperature are discussed. The effects of purity, grain size, and other processing variables on the elevated temperature thermal properties, including thermal conductivity, specific heat, and coefficient of expansion, are presented. Variations influencing chemical behavior are noted. Comparisons with some low-temperature properties are made to illustrate effects influenced by temperature and those independent of temperature. (auth)

705

STRESS-RUPTURE AND CREEP PROPERTIES OF QMV BERYLLIUM METAL. J. N. Hurd, R. G. O'Rourke, and W. W. Beaver (Brush Beryllium Co., Cleveland). p.95-115 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

Data for the stress-rupture and creep properties of QMV beryllium and associated materials, including those of a higher oxide content, are presented. The temperatures ranged from room temperature to 1500°F. The data showed that the addition of the oxide improved the creep strength of the beryllium. The data are discussed from the viewpoint of describing some phenomenological aspects of creep behavior of beryllium. In particular, a creep equation for elevated-temperature description is presented, and the variations of the parameters appearing therein are described. The effect of using creep stresses which exceed tensile elastic limits is pointed out. Data correlations based on the creep equation and methods for calculating the activation energy for creep in beryllium at elevated temperatures are given. The product of the minimum creep rates by the corresponding rupture times is discussed, and the conclusion is drawn that the activation energy for creep equals that for rupture. (auth)

706

TEST METHODS USED FOR ZIRCONIUM AND ZIRCONIUM ALLOY IN THE NAVAL REACTOR PROGRAM. Harold L. Kall (Carborundum Metals Co., Akron, N. Y.). p.116-23 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

In order to determine whether or not zirconium or zirconium alloy is suitable for use in the Naval Reactor Program, the material is subjected to a variety of tests. Chemical analyses for twenty elements are required, as well as the determination of the tensile properties, hardness, corrosion resistance in high-temperature water or steam, radiography, and sonic testing. A discussion of the various methods currently in use for these tests is given which includes a critical review of the analytical methods, both chemical and spectrographic. (auth)

707

EFFECTS OF HEAT TREATMENTS ON THE TENSILE AND CORROSION PROPERTIES OF ZIRCALOY 2. J. G. Goodwin, L. S. Rubenstein, and F. L. Shubert (Westinghouse Electric Corp., Pittsburgh). p.124-43 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

The effects of temperature, time at temperature, and cooling rate on the tensile and corrosion properties of Zircaloy-2 were studied. It was found that both tensile and corrosion properties were dependent upon cooling rate and when discussing the other variables, a cooling rate must be specified. In general, above 1700°F the yield strength increased and the ultimate strength decreased. Ductility decreased with increasing heat-treatment temperature above 1450°F. Cooling Zircaloy-2 at a rate greater than 90°F per min resulted in satisfactory corrosion resistance, whereas cooling at a rate less than that caused decreased corrosion resistance. Corrosion resistance of slowly cooled material decreased with increasing temperature above 1500°F. (auth)

708

SURVEY OF THE MECHANICAL PROPERTIES OF YTTRIUM AND YTTRIUM ALLOYS. O. N. Carlson, D. W. Bare, E. D. Gibson, and F. A. Schmidt (Iowa State Univ. of Science and Tech., Ames). p.144-59 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

A survey of the mechanical properties of yttrium and the effects of different elemental impurities and alloying additions on its tensile strength, ductility, and hardness are described. These properties were found to be relatively insensitive to small additions of most of these elements. Factors that influence the mechanical properties of yttrium to the greatest extent are heat treatment, degree of cold working, and grain orientation. Yttrium exhibits an anisotropy of hardness as determined from single-crystal studies and strain hardens extensively with a small degree of cold working. Its hardness is quite dependent upon the thermal history of the specimen. (auth)

709

DEOXIDATION AND DENITRIFICATION STUDIES OF CHROMIUM AND THE EFFECT ON LOW-TEMPERATURE PROPERTIES. H. L. Levingston and N. J. Grant (Massa-

chusetts Inst. of Tech., Cambridge). p.169-82 of "Symposium on Newer Metals. Presented at the Third Pacific Area National Meeting, San Francisco, Calif., October 15 and 16, 1959. ASTM Special Technical Publication No. 272." Philadelphia, American Society for Testing Materials, 1960.

The brittle-to-ductile transition temperature of commercial electrolytic chromium was investigated. Elements with a high affinity for oxygen, nitrogen, and carbon were added to the chromium. The reaction products that formed and their effect on several properties of chromium were correlated with ductility criteria. The investigation showed that the transition temperature of chromium, as determined by three-point bend tests, can be lowered by deoxidation and denitrification techniques as well as by grain size refinement and by testing at reduced strain rates. (auth)

Radiation Effects

710 BSR-230

Bendix Aviation Corp. Bendix Systems Div., Ann Arbor, Mich.

DIGEST OF IRRADIATION TOLERANCE OF ELECTRONIC COMPONENTS. D. A. Renken and R. M. Magee. May 1960. 338p. Contract AF33(600)-35026.

A summary of information on radiation effects on electronic components and related materials is presented. (W.L.H.)

711 FZA-54-026

Convair, Fort Worth, Tex.

MATERIAL AND COMPONENT UTILIZATION FOR NUCLEAR-POWERED VEHICLES (RADIATION EFFECTS DESIGN DATA). Sept. 30, 1959. 203p. Contract [AF]33 (600)-38926.

A study of material and component utilization for various nuclear-radiation levels was prepared. Material utilization (MU) factors based on material or component functional thresholds and various nuclear radiation levels are employed. An MU factor is defined as the quotient of the material or component functional threshold divided by the nuclear-radiation level. A list was prepared of MU factors normalized to one hr based on available radiation-effects data. The procedure required by the "user" of the MU factor listing is delineated. An example utilizing this procedure is discussed. It is intended to convey to the aircraft designer the necessary data required to evaluate various candidate materials and components in various nuclear-radiation environments. (auth)

712 GA-1201

General Atomic Div., General Dynamics Corp., San Diego, Calif.

RESEARCH IN RADIATION DAMAGE IN SEMICONDUCTORS. Final Report. J. W. Harrity, H. Horiye, V. A. J. van Lint, and E. G. Wikner. Feb. 10, 1960. 165p. Contract AF19(604)-3899. (AFCRC-TR-60-117; AD-235017). OTS.

The electrical properties (Hall effect, conductivity, and carrier lifetime) of germanium and silicon were studied as a function of electron and neutron irradiation. The carrier removal rate was 4.0 electrons per centimeter of 25-Mev electron path in germanium at 78°K, compared with 0.18 in silicon at 300°K. Two hole-trapping levels were found in germanium with energies of 0.15 and 0.27 ev. Evidence of annealing was observed between 78°K and room temperature in germanium. As a result of these studies, a radiation-resistant diode was fabricated using p-type germanium with a resistivity of ~0.20 ohm-cm as the base material. (C.J.G.)

713 GEAP-3387

General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

NUCLEAR SUPERHEAT PROJECT, FABRICATION, IRRADIATION AND EVALUATION OF SUPERHEAT FUEL ELEMENT SH-1 AND SH-2. E. A. Lees, R. F. Boyle, and C. N. Spalaris. Apr. 7, 1960. 36p. Contract AT(04-3)-189, Project Agreement 13. OTS.

The fabrication, irradiation, and evaluation of the first two superheat fuel assemblies are described in detail. Experimental data indicate that, in general, the nuclear-superheat fuel elements performed satisfactorily under the testing conditions used. Certain problem areas which will influence future fuel-element designs are defined. (auth)

714 HW-64688

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

IRRADIATION EFFECTS IN CLADDING MATERIALS. J. E. Minor. Apr. 8, 1960. Decl. May 19, 1960. 23p. Contract AT(45-1)-1350. OTS.

Zircaloy-2, stainless steel, and aluminum alloys were irradiated in the form of cladding on metallic and ceramic fuel elements. Several aspects of fuel behavior as influenced by these cladding materials are discussed. Measurements were made of the variation of operating temperature with time when these materials are used in the unbonded form on metallic elements. Changes in the relative strength properties of fuel, cladding, and bond were observed in the Zircaloy-2–uranium system, as well as changes in the interface between stainless steel and uranium and the interface between Zircaloy-2 and UO_2. (W.D.M.)

715 IOP-4-A

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

METHOD OF APPLYING FOR USE OF NRX AND NRU IRRADIATION AND EXAMINATION FACILITIES AT CHALK RIVER BY EXTERNAL ORGANIZATIONS. Aug. 1960. 35p. (AECL-1075). AECL.

A manual is presented containing information on the approved method for submission of proposals for experimental irradiations in NRX or NRU. (J.R.D.)

716 NP-9305

Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.

MONTHLY ACCESSION LIST NO. 39 [ON RADIATION EFFECTS DATA]. Sept. 15, 1960. 23p. Project No. 4458. Contract AF33(616)-7375.

717 ORNL-1722

Oak Ridge National Lab., Tenn.

EFFECT OF FISSIONABLE PARTICLE SIZE ON FISSION DAMAGE IN GRAPHITE. R. H. Kernohan. Apr. 21, 1954. Decl. Feb. 24, 1960. 42p. Contract [W-7405-eng-26]. OTS.

Molded-graphite test specimens containing 5 wt. % enriched uranium oxide particles were irradiated for 1 month in the ORNL Graphite Reactor along with control specimens containing no uranium oxide. Specimens in the form of rectangular bars 3 in. long were measured both before and after irradiation in order to find possible changes in weight, modulus of elasticity, electrical resistivity, and thermal conductivity. The purpose of these tests was to investigate the degree of fission-fragment damage as a function of UO_2 particle size in the graphite

matrix. Results showed that decreases in weight and thermal conductivity and increases in electrical resistivity and modulus of elasticity of the same order of magnitude occurred in all specimens, but were particularly severe for specimens in which the UO_2 particle size was less than 44 μ. Annealing studies up to 750°C indicated that annealing of fission damage did not occur. The amount of fission damage was compared with results of theoretical calculations and found to be in fair agreement. (auth)

718 WCAP-6044

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

NUCLEAR MATERIALS CONTROL SYSTEM (NMCS), PHASE II. A METHOD FOR THE NON-DESTRUCTIVE ANALYSIS OF POWER REACTOR FUEL ELEMENTS. B. Jennings. July 22, 1960. 41p. Contract AT(30-1)-2176. OTS.

A technique for performing a nondestructive assay for U^{235} on large low-enrichment power-reactor fuel assemblies has been developed for use in a Nuclear Materials Control System. The primary problem in the development of a suitable assay procedure is to obtain adequate assay sensitivity to fuel in the interior of the element under test. The method chosen to achieve this penetration is to bombard a moderated fuel assembly with fast neutrons. The fast neutrons penetrate into the fuel assembly, are moderated by the water, and produce thermal and resonance fission in U^{235}. In order to minimize the penetration required, the fuel assembly is rotated about its major axis so that the fast-neutron source irradiates a short length of the assembly at each assay. A measure of the number of fission events, and hence of U^{235} content, is obtained by counting the number of delayed neutrons released in the fission process. The above technique has been verified experimentally by using 2.6-Mev neutrons from a Cockcroft-Walton generator and by measuring the delayed neutrons produced in a Yankee type fuel assembly. The results show that the number of delayed neutrons for constant fast-neutron activation is directly proportional to the uranium in the assembly, except for the inner 10% where the sensitivity decreases. (auth)

719 AEC-tr-4221

PRECIPITATION OF HELIUM IN NEUTRON IRRADIATED GLUCINE. (Précipitation d'Hélium dans la Glucine Irradiée par des Neutrons). Henri Frisby, Auguste Bisson, and Roger Caillat. Translated by Al Monks (Oak Ridge National Lab.) from Compt. rend. 248, 672-3(1959). 5p. (includes original, 2p.). JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 7894.

720 DEG-Inf. Ser.-104

THE EFFECT OF THERMAL TREATMENT ON THE PROPERTIES OF SINTERED BERYLLIUM OXIDE OF VARIOUS DENSITIES, IRRADIATED BY NEUTRONS. J. Elston, C. Gewiss, and C. Labbe. Translated by W. R. Dines (U.K.A.E.A., Risley) from Compt. rend. 249, 1635-7 (1959). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 2779.

721

ANNEALING OF X-RAY INDUCED SURFACE HARDENING IN NaCl. R. Cuypers and S. Amelinckx (Laboratorium voor Kristalkunde, Ghent, Belg.). Acta Met. 8, 551-3(1960) Aug.

Rocksalt crystals were irradiated with x rays. The produced surface hardening and the resoftening due to annealing were followed. The activation energy of the process associated with the annealing at 150 to 300°C was derived. From the results, it is assumed that clusters of point defects are the principal cause of the surface hardening. For annealing below 300°C the resoftening would mainly result from the growth in size of these aggregates, and their corresponding decrease in number. (auth)

722

THE EFFECT OF X AND α IRRADIATION ON FADED ROCK SALT. Hans Adler (Akademie der Wissenschaften, Vienna). Acta Phys. Austriaca 13, 369-86(1960). (In German)

As a complement to investigations made by others, it is shown that the secondary coloring of rock salt (R centers and colloids) is not stable with respect to x and α irradiation and is reconverted, under the effect of such irradiation, to F centers. In additive colloid-colored rock-salt crystals, a partial decomposition of the colloid was observed under x irradiation. A possible mechanism of the redyeing under irradiation is discussed. (tr-auth)

723

RELAXATION OF ELASTIC STRESSES UNDER NEUTRON IRRADIATION. S. T. Konobeevskiĭ. Atomnaya Energ. 9, 194-200(1960) Sept. (In Russian)

The effects of neutron irradiation on the relaxation of elastic stress in a plain coil made of U and Mo alloys and on the relaxation of microstructures causing the expansion of x-ray-diffraction lines in rolled uranium are discussed. Theoretical concepts found in published literature are analyzed and correlated with the obtained experimental data. (tr-auth)

724

ANNEALING KINETICS OF NEUTRON-IRRADIATED ALUMINIUM AND COPPER. T. H. Blewitt, R. R. Coltman, and C. E. Klabunde (Oak Ridge National Lab., Tenn.). Australian J. Phys. 13, 347-53(1960) July.

Activation energies for the annealing of copper and aluminum following reactor bombardment near 4°K were measured in the range from 10 to 40°K. Both the changes in the slope and the isothermal technique methods were utilized with the assumption that a constant activation energy existed. Computations of the number of jumps involved from the measured activation energy resulted in an impossibly small number. It is obvious that the method for the determination of the activation energies is not applicable, probably because of the nonuniqueness of the activation energy. (auth)

725

A CONTRIBUTION TO THE STUDY OF THE THERMAL PROPERTIES OF NaCl:Ca CRYSTALS IRRADIATED WITH X-RAYS. Jaraslan Trnka (Inst. of Technical Physics, Czechoslovak Academy of Sciences, Prague). Československ. časopis pro fysiku 8, 749(1958). (Translated from Referat. Zhur. Fiz. No. 3, 1960, abstract No. 6209)

In order to investigate the influence of x-ray irradiation in the process of annealings, the temperature difference, ΔT, of the irradiated and nonirradiated sodium chloride crystals was registered. Crystals with molecular contents of 0.2, 0.05, and 0.002% calcium were investigated. The x-ray irradiation was carried out at 50 kev and 30 ma through a beryllium window for 2 hr. In each of the experiments a maximum was observed on the curve showing the dependence of ΔT on the oven temperature. With increasing calcium concentration, the position of the maximum shifted toward the lower oven temperatures.

726

POTENTIALS OF Pt- AND Au-ELECTRODES IN HNO_3

AND $NaNO_3$ SOLUTIONS UNDER IONIZING RADIATION EFFECT. N. A. Bakh and V. D. Bityukov (Inst. of Electrochemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk No. 8, 1358-68(1960) Aug. (In Russian)

Comparisons were made of plutonium and gold electrodes. The dependence of potentials on nitrate solution concentrations and the effects of radiation on the potentials indicate that the products of nitrate ion radiolysis participate in determining their potentials. The products of water radiolysis and molecular hydrogen also participate in determining the potential of platinum electrode. (R.V.J.)

727

FAST NEUTRON BOMBARDMENT OF GERMANIUM AND SILICON ESAKI DIODES. J. W. Easley and R. R. Blair (Bell Telephone Labs., Inc., Whippany, N. J.). J. Appl. Phys. 31, 1772-4(1960) Oct.

The fast-neutron irradiation behavior of germanium and silicon Esaki diodes was experimentally examined. The dominant change produced was an increase in the "excess" current which was proportional to integrated neutron flux. The observed increase in the vicinity of the current minimum was approximately 2.6×10^{-15} and 1.1×10^{-14} amp/fast neutron for germanium and silicon diodes, respectively. Substantial changes resulted in the voltage-current characteristics of the diodes employed in the decade of exposure between 10^{16} to 10^{17} fast neutrons/cm^2 for germanium diodes and between 10^{15} to 10^{16} fast neutrons/cm^2 for silicon diodes. One kilomegacycle cavity oscillators employing germanium diodes exhibited a marked reduction in power output in the decade of exposure between 10^{16} to 10^{17} fast neutrons/cm^2. The magnitude of the decrease was in approximate agreement with the observed bombardment reduction of diode negative conductance. (auth)

728

STUDY OF IRRADIATION EFFECTS AND THE $H^2 + H^2$ BUILDUP IN TANTALUM. A. F. Gabrysh, H. Eyring, M. E. Wadsworth, G. S. Baker, and T. Ree (Univ. of Utah, Salt Lake City). J. Appl. Phys. 31, 1785-91(1960) Oct.

The irradiation effects and the increase of neutron yield from the deuterium-deuterium reaction in tantalum was studied at a bombarding energy of 350 kev and a target current 100 μa. Saturation (the point at which neutron yield became a steady maximum) was reached in a new target, maintained at temperatures below 45°C, after about 2 hr of steady bombardment or on the order of 1 coulomb of deuterons per square centimeter. The irradiated targets were annealed at temperatures from 45 to 770°C. A thermal analysis showed that a prominent exothermic maximum in the annealing spectrum occurred at approximately 612°C. This maximum was associated with an increase in pressure, indicating an abrupt increase in diffusion of deuterium from the target at this temperature. From a study of diffusion of deuterium from the specimen at three temperatures, an activation energy of 0.24 ev was calculated for diffusion of deuterium in tantalum. X-ray traces were taken of the specimen before and after bombardment and after annealing. These showed an expansion of the lattice together with changes in line intensities indicating a distortion in the lattice structure. (auth)

729

ON THE TEMPERATURE OF AN OBJECT IRRADIATED WITH ELECTRONS. S. Yamaguchi (Inst. of Physical and Chemical Research, Tokyo). J. Appl. Phys. 31, 1825-6 (1960) Oct.

Invar with a Curie temperature of 120°C was used to study temperature elevation in an object caused by electron bombardment. A diffraction pattern of the specimen was photographed before exposure. The diffraction pattern of a warmer specimen that had been irradiated for 2 min was superimposed on the original pattern. This figure showed eccentricity among the diffraction rings implying that the Lorentz effect of the specimen on the electrons depends on the temperature of the specimen. A double diagram obtained from specimens irradiated 2 and 4 min showed no eccentricity, which indicated that the specimens that were irradiated longer than 2 min exceeded the Curie temperature and became paramagnetic. (M.C.G.)

730

ELECTRON MICROSCOPE STUDIES OF DAMAGE IN IRRADIATED URANIUM DIOXIDE. H. W. Newkirk, Jr., J. L. Daniel, and B. Mastel (General Electric Co., Richland, Wash.). J. Nuclear Materials 2, 269-73(1960) Sept. (In English)

A description is given of the effects of a short-term reactor irradiation on uranium dioxide specimens of moderate density (87 to 94% of theoretical, 10.97 g/cc). The specimens were examined by fractography, conventional electron microscopy, and precharacterized surface electron microscopy techniques. The results suggest that reactor irradiation can (1) change the mode of fracture from transcrystalline to intercrystalline, (2) create holes or cracks at grain boundaries, and (3) activate transport mechanisms which distort free surfaces. (auth)

731

OBSERVATIONS CONCERNING THE RADIATION HARDENING IN COPPER AND NICKEL. I. G. Greenfield and H. G. F. Wilsdorf (Franklin Inst., Philadelphia). Naturwissenschaften 47, 395-6(1960). (In English)

Single crystals of copper were irradiated with neutrons in a reactor to a dose of 2×10^{19} nvt (integrated flux) at approximately 70°C and were subsequently deformed by various tensile stresses. The crystals were electrolytically polished to 1000 A thickness and examined electron microscopically. The most obvious feature of the irradiated copper was dark spots with diameters from 50 to 250 A. These were probably caused by small vacancy condensation loops. Heavily kinked and intertwined glide dislocations, previously observed in deformed irradiated nickel, were also present. It was suggested that the kinks and intertwined loops were formed when glide dislocations had attracted vacancies and vacancy groups which, after they had condensed on them, formed kinks. It was concluded that the high yield stress after irradiation is caused by the profuse kinking of the glide dislocations. The low rate of work hardening is explained by the clearing of channels free of obstacles. (J.S.R.)

732

SOME IRRADIATION EFFECTS IN NONMETALLIC CRYSTALS. M. C. Wittels and F. A. Sherrill (Oak Ridge National Lab., Tenn.). p.269-88 of "Advances in X-Ray Analysis. Volume 3." William M. Mueller, ed. New York, Plenum Press, 1960.

Nonmetallic crystals with a variety of structures and chemical compositions were exposed to fission spectrum neutrons in a core position of the Low Intensity Test Reactor, and examined by x-ray diffraction techniques. Wherever possible, single crystals were employed, and the neutron dosages ranged between 10^{19} and 10^{21} neutrons/cm^2 at a temperature of ~85°C. In no case was a special technique used for examining radioactive materials because the problem of heavy-induced radioactivity was greatly reduced by working with crystals weighing 1 mg or less. Both film and counter measurements were employed. (auth)

733
AEOLOTROPY OF THE RADIATION-INDUCED EXPANSIONS OF SILICON CARBIDE. William Primak (Argonne National Lab., Ill.). p.385-7 of "Silicon Carbide." New York, Pergamon Press, 1960.

Seven tabular fragments of hexagonal (presumably α-) silicon carbide were ground into a shape suitable for Fizeau interferometer measurements, in which their lengths were compared with similar vitreous silica posts. Three of these were irradiated in a nuclear reactor for about 1.08×10^{20} damaging neutrons/cm^2, three for about 1.80×10^{20}, and one was retained as a standard. They were measured again after the irradiations, and their densities were also determined. From these data the fractional expansions along the optic axis and perpendicular to it were calculated and were found to be in the ratio 0.97 for both irradiations. (auth)

PHYSICS

General and Miscellaneous

734 AAEC/E-46
Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales.
A NEUTRON DIFFRACTION DETERMINATION OF THE MAGNETIC FORM FACTOR FOR Ni^{2+} IN NiO. T. M. Sabine. Feb. 1959. 7p.

Results of nuclear and magnetic reflection measurements on NiO crystals are presented. Data are given on nuclear and magnetic intensities and on the form factor for Ni^{2+}. (J.R.D.)

735 AFBMD-TR-60-183
Avco Corp. Avco-Everett Research Lab., Everett, Mass.
LOW-DENSITY SHOCK TUBE FOR CHEMICAL KINETIC STUDIES. Research Report 91. Shao-Chi Lin and Walter I. Fyfe. July 1960. 38p. Contract AF04(647)-278.

The general problem of high-speed flight through the earth's atmosphere often involves the question of chemical kinetic rates in the hypersonic flow-field around the object. At low altitudes where the characteristic dissociation and ionization times of high-temperature air are much shorter than the flow transit time over the object of interest, the assumption of quasi-equilibrium flow is justified. However, at higher altitudes where the dissociation and ionization times become comparable to the flow transit time, the temperature and chemical composition of the flow field will be determined by the specific chemical kinetic rates as well as by the conservation and transport equations. While the high-temperature shock tube has been found to be a very useful tool for the study of many chemical kinetic problems, the application of it to the study of reaction rates in diatomic gas mixtures (such as air) has unfortunately been limited to either low shock strength or gas mixtures that have been diluted by chemically inert gases. One of the reasons has been that at the relatively high sample gas pressure where shock tubes can normally operate, the very fast specific rates that characterize binary reactions of diatomic gases tend to produce such thin reaction zones at high shock strengths that the relaxation phenomena of interest often cannot be resolved by ordinary shock-tube techniques. Some problems concerning the extension of high-temperature shock-tube experiments to low gas densities are discussed. Specific examples are cited on the operation and actual performance of a 24-in.-diameter shock tube that was constructed for chemical kinetic studies at gas densities in the neighborhood of 10^{-5} normal atmosphere (i.e., about 80 km simulated altitude). Some preliminary results on the dissociation and ionization rates, as well as the visible radiation profile, behind strong normal shocks in air $12 < M_s < 22$) at these low densities are presented. (auth)

736 AFCRC-TN-60-400
Air Force Cambridge Research Center. Geophysics Research Directorate, Mass.
A DIFFUSION-DEPOSITION MODEL FOR IN-FLIGHT RELEASE OF FISSION FRAGMENTS. Air Force Surveys in Geophysics No. 123. M. L. Barad, D. A. Haugen, and J. J. Fuquay. Apr. 13, 1960. 32p. Project 8644. OTS.

A diffusion-deposition model is developed for use in estimating dosage levels due to in-flight release of fission fragments from a nuclear-powered aircraft. The model is based on the work of Sutton for diffusion and the work of Chamberlain for deposition. The model considers an elevated instantaneous point source and an elevated instantaneous line source oriented at an arbitrary angle to the mean wind direction. Suggested values of the various deposition, rain-out, and diffusion parameters to be used with the model are presented along with a qualitative discussion of the uncertainties of the model and the suggested parameters. (auth)

737 AFOSR-TN-60-893
California. Univ., Berkeley.
SOME EFFECTS OF HOLE-HOLE INTERACTIONS IN SYSTEMS OF FERMIONS. J. Sawicki. [1960]. 17p. Contract AF49(638)-327.

A generalized reaction matrix of the Brueckner theory involving the effects of hole-hole interactions in large systems of fermions is discussed. Corrections to the real part of the single-particle excitation energy are estimated for the cases of nuclear matter and liquid He^3. The problem of the damping factor (i.e., the imaginary energy shift) is discussed. (auth)

738 AFSWC-TN-58-18
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
INVESTIGATION OF WAVE PROPAGATION IN SEMI-SOLIDS. Final Report. William F. Riley, James W. Dally, and A. J. Durelli. Mar. 1958. 158p. ARF Project K115. Contract AF29(601)-465.

During the course of the program a microflash method was developed for recording photoelastic patterns and grid deformations simultaneously. A soft photoelastic material (Hysol 8705) was selected as the model material and its static and dynamic properties (physical and optical) were completely determined. By using the photoelastic pattern, the grid measurements, and the material properties it was possible to determine stress distributions resulting from impact type loadings. As an indication of the procedure to be used, the principal stresses along the vertical diameter of a disk subjected to a diametrical-compressive impact loading were determined. In another phase of the program the use of the Fastax camera was continued and applied to the study of wave-propagation phenomena in large plates subjected to air-blast and explosive type loadings. This series of tests clearly showed that a shock tube can be used in conjunction with photoelastic models for air-blast studies. The fringe patterns obtained were satisfactory for studying the over-all wave-propagation phenomena. In regions where more detail was required than could be recorded on the 16mm Fastax film, the microflash unit gave suitable records. The performance of barium titanate and diaphragm type pressure gages embedded in soil or soft

rubber specimens and subjected to impact loadings was studied. Pendulums were used for this purpose. In general, the barium titanate gages recorded a pressure which compared favorably with an independently determined pressure when the loading rate was high. The diaphragm gages seemed to perform better when low loading rates were used. (auth)

739 AFSWC-TR-59-60

Republic Aviation Corp., Farmingdale, N. Y.

FORCE-FREE MAGNETIC FIELDS. B. Raab. Sept. 15, 1959. 38p. Project No. 7811. Contract AF29(601)-1218. (MSD-206-951; AD-236697).

The analytic solution of the force-free field equation and the implications of matching this solution to a useful set of boundary conditions are discussed. Several interesting properties of force-free fields are discussed in detail. These properties include minimum state of energy that a closed system may attain, minimum joule heat loss for a given magnetic energy density (maximum magnetic energy for given mean-square current density), trapping of charged particles above a given energy, and free decay without causing fluid motion. (auth)

740 ARF-4132-8

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

THE EFFECT OF END CONDITIONS ON THE DYNAMIC RESPONSE OF CYLINDRICAL SHELLS. R. L. Chiapetta and P. G. Hodge, Jr. July 1960. 76p. Contract AT(11-1)-528. OTS.

A circular cylindrical shell of a rigid plastic material is uniformly loaded by a radial step pressure pulse. Explicit formulas are obtained for the maximum deformation in the shell as a function of the shell geometry and pressure magnitude. It is found that for moderately long shells, the deformation is essentially independent of the support conditions at the end of the shell. (auth)

741 CERN-60-27

European Organization for Nuclear Research, Geneva.

DESIGN AND CONSTRUCTION OF A 200 KGAUSS PULSED MAGNET. M. Morpurgo, L. Hoffmann, and W. M. Gibson. Aug. 4, 1960. 27p.

A pulsed magnet was constructed for a field of ~200 kgauss. The magnet consists of two air-cored Bitter type coils energized by a capacitor bank. A description of the magnet and switching unit is given. (C.J.G.)

742 CF-60-9-44

Oak Ridge National Lab., Tenn.

SOME ELEMENTARY RESULTS CONCERNING ESCAPE PROBABILITIES OF PARTICLES OF FIXED RANGE GENERATED IN SPHERES. Melvin Tobias. Sept. 14, 1960. 5p. OTS.

Studies were made on the escape probabilities of particles of a fixed range which are generated uniformly in spheres. Equations for determining the escape probability, mean path length, and path length function were derived. (C.J.G.)

743 CU(PNPL)-205

Columbia Univ., New York. Pegram Nuclear Physics Labs.

PROGRESS REPORT FOR APRIL, MAY, JUNE 1960 TO THE UNITED STATES ATOMIC ENERGY COMMISSION. 49p. Contract AT-30-1-GEN-72. OTS.

Neutron transmission measurements were made on $PbBr_2$, PbI_2, Cs, Pr_6O_{11}, Tm_2O_3, and thorium samples were obtained by the flat-detector method. The tunnel construction for the 200 m flight path was essentially completed, and plans for the helium flight path were tested and studied. Preliminary investigations on thick Fe, Al, Cu, and Zr plates with the B^{12} flat detector and zero delay revealed strong structure effects. Studies were initiated on the feasibility of using high-resolution solid-state detectors for the measurement of the mass distribution of fission fragments in U^{235}, U^{233}, and Pu^{239}. Boron samples were used in B loading specifications for reactors and as a standard for measurement of other cross sections. The total neutron-cross-section measurements on MnO over the range from 0.5 to 0.0006 ev at room temperature were completed. Slow-neutron scattering from hydrogen compounds at room temperature was studied. The study of the charge-exchange reaction in $Be^9(He^3,t)B^9$ was continued. Both angular distribution and excitation curves were investigated. Work on the compilation of a table of total beta-decay energy was resumed. The results on the nuclear electric monopole transitions in O^{16}, Ca^{40}, Ge^{72}, and Zr^{90} are summarized and tabulated. Precise measurement of the $N^{14}(n,p)$ total cross section at 0.4926 was made. Several trial runs of (d,n) reactions on O^{16}, C^{13}, and F^{19} were carried out. Several components of the He^3 gas handling system were successfully tested and completed. The 13-Mev proton beam from the cyclotron was finally brought to the experimental area by two sets of magnetic quadrupole lenses and a bending magnet. Investigation of the Mössbauer effect of the 14.4-kev line in Fe^{57} was initiated. Measurement of the lifetime of the Ca^{42} second excited state and the Sc^{47} first excited state is reported. For the investigation of monoenergetic positrons in Bi^{206} decay, a low-background Geiger counter was developed. Temperature dependence of the low-momentum excitations in a Bose gas of hard spheres was calculated by the pseudo-potential method to an order beyond that previously known. A vibratory mechanism to provide Doppler motion of the Mössbauer effect was designed and constructed. The construction of a coincidence circuit using cascaded 2N1195 transistors was completed. Circuit diagrams are given for the 10-channel time-of-flight analyzer to be used in the investigation of the neutrino recoil in He^6 beta decay. An automatic-switching mechanism for the 256-channel analyzer was designed and installed. A current regulator with a short-term stability better than 30×10^{-6}, and a long (10 hr) drift of 50×10^{-6} per hour, was constructed and placed in operation. (For preceding period see CU(PNPL)-203.) (W.D.M.)

744 GA-1476

General Atomic Div., General Dynamics Corp., San Diego, Calif.

CONVERSION OF HEAT TO ELECTRICITY IN SOLIDS AND PLASMAS. Werner B. Teutsch. Aug. 8, 1960. 13p.

Presented as paper 1201-60 at the American Rocket Society Semi-annual Meeting, Los Angeles, California, May 9-12, 1960.

The general aspects of thermoelectricity are reviewed in light of recent developments. The theory of conversion of heat to electricity in solid thermoelements is reviewed. The physical significance of the various parameters that determine the figure of merit of a solid thermoelement is discussed. Conversion of heat to electricity in a cesium cell is considered in some detail. The cesium cell is primarily a thermionic device in which the added cesium becomes partly ionized so that it may be regarded as a plasma. For very high cesium pressures, such a device may be described in a manner completely equivalent to the discussion for solid thermoelements. However, at lower pressures the device is better described as a thermionic heat-to-electricity converter, in which the major function of the cesium is to provide space charge cancellation for

the thermionic electrons. The cesium cell may then be described by a fairly simple model which is in good qualitative agreement with experiments. (auth)

745 IDO-16605

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

COORDINATES FOR CALCULATING VIBRATIONAL FREQUENCIES IN CHAIN MOLECULES. H. L. McMurry. Aug. 31, 1960. 54p. Contract AT(10-1)-205. OTS.

Recent studies of the energy exchanges of slow neutrons with molecules has led to work on the vibrational frequencies and associated normal modes of hydrocarbons. A general method is given for obtaining coordinates suited to calculating the vibrational frequencies for any symmetrical chain molecule. The method is well suited to machine calculations. It is particularly well adapted to those hydrocarbons in which it is justifiable to treat vibrations involving mainly motions of hydrogen atoms separately from those involving translational and rotational displacements of groups like CH_3, CH_2, etc. The method is illustrated by detailed application to normal paraffins. (auth)

746 LMSD-5135

Lockheed Aircraft Corp. Missile Systems Div., Palo Alto, Calif.

ABSORPTION COEFFICIENTS OF AIR FROM 22,000° TO 220,000°. Final Report. Baxter H. Armstrong, Dan H. Holland, and Roland E. Meyerott. Aug. 15, 1958. 168p. Contract AF29(601)-524. (AFSWC-TR-58-36).

The photoelectric and free-free absorption coefficients of air were computed over the temperature range 2 to 20 ev, density range $\sim 10^{-5}$ normal to normal, and energy range 1 ev to 1 kev. The occupations of ionic states were computed with the grand-canonical ensemble statistical method of Brachman and Meyerott. For terms of principal quantum numbers 2 and 3, empirical energy values were used where known, and estimates by isoelectronic interpolation, or the Bacher-Goudsmit method, were made where empirical values were lacking. For $n \geq 4$, the Bohr formula with quantum defects was used, and separate angular momentum levels were included to $n = 9$. Multiple excitations were partially included by using one-electron levels of ionic cores for all core possibilities of the $n = 2$ shell. Screened coulomb gaunt factors were used, and fractional parentage coefficients were employed in order to account for transitions from equivalent electron states. (auth)

747 MND-P-2355

Martin Co. Nuclear Div., Baltimore.

ADVANCED THERMOELECTRIC POWER SYSTEM. Final Report. Robert J. Harvey. 1960. 20p. Contract AT(30-3)-217. OTS.

Development of a radioisotope-fueled thermoelectric power-conversion system for the SNAP program is discussed. The generator operates at somewhat less than 1% over-all efficiency, has a power output of approximately 1.45 watts, and has a specific power of 0.142 watts per pound. The power-flattening device did not perform as expected. A second generator is also described which produces a maximum power of 1.6 watts, has a maximum efficiency of 1.20%, and has a specific power of 0.32 watts per pound (exclusive of the weight of the heat source). (auth)

748 MND-P-2363

Martin Co. Nuclear Div., Baltimore.

PRELIMINARY SAFETY ANALYSIS LOW POWER CERIUM-144 GENERATOR. June 1960. 33p. Contract AT(30-3)-217. OTS.

A safety analysis of small Ce^{144} fueled thermoelectric generators for use in terrestrial satellite systems is given. The Ce^{144} fuel is enclosed in a capsule of Haynes-25, which is to be maintained at 580°C during operation. Lead telluride thermoelectric elements surround the capsule and are contained in an outer stainless steel shell. In one configuration a second shell filled with Hg is used for biological shielding. The biological shield reduces the direct radiation dose from decay gammas and bremsstrahlung to 90 mr/hr at 3 ft. The integrity of the fuel capsule under the spectrum of launch failure forces is considered. These forces include internal pressure, external forces from shock overpressures and impact, corrosion, and propellant fires. Following successful missions, the fuel is to be released in the stratosphere at a time when the source strength is about 4000 c. Resultant ground concentrations would be 2×10^{-9} c/sq mile and 0.053 mc/sq km for temperate zone and prompt stratospheric releases, respectively. (C.J.G.)

749 MND-P-2398

Martin Co. Nuclear Div., Baltimore.

SNAP III FINAL PERFORMANCE TEST SUMMARY. James D. Long. Aug. 1960. 57p. Contract AT(30-3)-217. OTS.

SNAP III, a 3- to 5-watt electrical generator, was designed as a proof-of-principle device in the development of radioisotope-powered thermoelectric power-conversion systems. A program involving five development areas was employed in achieving this aim. These areas were: (1) generator development, fuel encapsulation, and handling techniques; (2) system safety studies; (3) system dynamic tests; (4) system parametric performance tests; and (5) system life tests. Particular attention was given to fuel encapsulation and handling techniques, system safety studies, system parametric performance tests, and system life tests. (auth)

750 NASA-TR-R-81

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

ALIGNMENT CHARTS FOR TRANSPORT PROPERTIES VISCOSITY, THERMAL CONDUCTIVITY, AND DIFFUSION COEFFICIENTS FOR NONPOLAR GASES AND GAS MIXTURES AT LOW DENSITY. Richard S. Brokaw. 1960. 36p.

Nomographs are presented from which rapid calculations of the low-pressure transport properties of nonpolar gases and gas mixtures can be made. Calculations for pure gases are based on the rigorous kinetic theory of gases as applied to a realistic intermolecular force law. Mixture viscosities and conductivities are calculated from good approximations derived from rigorous theory. The properties are calculable with a precision of 2% or better. Force constants are tabulated for 65 gases. (auth)

751 NP-9182

Detroit. Univ.

THE STUDY OF THE PROPERTIES OF SINGLE CdS AND ZnS CRYSTALS. Technical Report No. 6. S. J. Czyzak, H. Payne, W. M. Baker, J. C. Manthuruthil, and T. M. Bieniewski. Sept. 1, 1960. 47p. Project NR 015-218. Contract Nonr-1511 (01).

The progress in the theoretical and experimental investigation of single-crystal properties is reported. The studies during the period were particularly concerned with the optical, electrical, and structural properties which might suit them to applications such as detectors and crystal counters. Dielectric constant measurements on CdS and ZnS single crystals at 25° and −65°C were completed. Index-of-refraction measurements were also completed to

1.4 μ, and extension of these measurements to 25 μ is in progress. Thermal-conductivity studies will receive major attention during the next report period. (For preceding period see NP-8015.) (J.R.D.)

752 NP-9231
Westinghouse Electric Corp. Research Lab., Pittsburgh.
MAGNETOHYDRODYNAMIC POWER GENERATION. Scientific Paper 6-40509-2-P2. S. Way. Apr. 1, 1960. 46p.

The straight-flow crossed-field type of magnetohydrodynamic (MHD) generator is discussed. The theory of such generators is examined and the governing equations are set up. Some recent experimental work on a constant-area MHD generator operating on combustion products of furnace oil and oxygen is also discussed along with the complete thermal cycle (open or closed) in which the MHD generator might be applied. A numerical example is given for a closed cycle using helium and cesium. (auth)

753 NP-9239
California Inst. of Tech., Pasadena. Jet Propulsion Lab.
ASTRONAUTICS INFORMATION. OPEN LITERATURE SURVEY. VOLUME II, NUMBER 8 (ENTRIES 22,421–22,670). Aug. 1960. 69p. Contract NASw-6.

A bibliography containing 249 references pertaining to communications, guidance, and propulsion of rockets, space vehicles, and satellites; properties of cosmic radiation; relativity theory; and solar phenomena is presented. (C.J.G.)

754 NP-9247
California Inst. of Tech., Pasadena. Jet Propulsion Lab.
SPACECRAFT SECONDARY POWER REQUIREMENTS DURING THE SIXTIES. Technical Release No. 34-38. R. C. Hamilton and E. G. Laue. Apr. 10, 1960. 31p. Contract NASw-6.

It is shown that no more than 3 kw of electrical power will be required for the secondary electrical power systems during the 1960-65 period. It is concluded that within 15 yr, megawatts of electrical power will be required for interplanetary electrical propulsion, and for permanent manned bases on the moon and planets. (W.D.M.)

755 ORNL-1795
Oak Ridge National Lab., Tenn.
ELECTRONUCLEAR RESEARCH DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1954. F. T. Howard, ed. Nov. 18, 1954. Decl. Aug. 12, 1959. 29p. Contract W-7405-eng-26. OTS.

Two new targets for the 86-in. cyclotron were designed, and production yields for 14 radioisotopes are summarized. A new beam-deflector system was completed. Excitation functions for N^{14} and O^{16} by N^{+3} ion beams were measured. Magnetic and radiofrequency requirements of the proposed 114-in. cyclotron are discussed. High enrichments of plutonium isotopes were obtained by electromagnetic separation. (For preceding period see ORNL-1670.) (W.D.M.)

756 ORNL-2994(p.266-9)
Oak Ridge National Lab., Tenn.
AEROSOL PROJECT. F. G. Karioris, B. R. Fish, and M. B. Edwards.

An exploding-wire aerosol generator for the production of U_3O_8 aerosols was constructed and is undergoing tests. Preliminary results show that typical fume particles 0.02 μ in diameter are produced and that the yield is about (85 ± 4)% for 10-mg uranium wires. (auth)

757 SC-4440(RR)
Sandia Corp., Albuquerque, N. Mex.
PARTICLE MOTIONS NEAR EXPLOSIONS IN HALITE. Final Report. B. F. Murphey. June 1960. 88p. Project COWBOY. OTS.

Comparative peak particle velocities and peak displacements were measured for coupled (tamped) and decoupled (by a cavity) explosions of high explosive in halite. Recordings are illustrated of particle velocity vs. time in the salt medium and of pressure vs. time on the cavity wall. Peak particle velocities from tamped shots decrease in amplitude as distance$^{-1.65}$ over distances equivalent to 40 to 800 ft for 1000 lb of high explosive. Permanent displacements in the region of observation were 0.01 in. or less and therefore were not accurately observable with available measuring apparatus. Decoupling factors observed directly apply only to close-in stations. One method of extrapolating close-in data to compute distant decoupling factors gives numbers ranging from 40 to 100 for these particular experiments. Extrapolation to nuclear explosions still requires calculation or experiment and is not attempted here. (auth)

758 SC-4448(RR)
Sandia Corp., Albuquerque, N. Mex.
PRESSURE OBSERVATIONS IN THE CRATER VICINITY DURING THE EXPLOSION OF SMALL CHARGES IN DRY SAND. R. P. Reed and W. E. Taylor. May 6, 1960. 31p. OTS.

Characteristics of the pressure pulse from the explosion of ½-oz RDX spheres buried in dry sand were measured at scaled distances from 0.26 to 5.16 ft/lb^{⅓}. Variables were depth of charge burial, distance from the charge center, and relative size of sand particles in which the explosion was performed. Measurements of the pressure pulse were made from recordings of the pressure-induced strain wave propagated in strain-gage instrumented metal rods which extended into the crater zone. (auth)

759 SC-4449(RR)
Sandia Corp., Albuquerque, N. Mex.
FINAL DESIGN OF SANDIA'S SUPERSONIC PARACHUTE TEST VEHICLE. M. T. Kane and B. L. Barth. Sept. 1960. 45p. OTS.

The final aerodynamic and mechanical design of Sandia's supersonic parachute test vehicle is presented. This vehicle, a two-stage rocket-boosted ground-launched vehicle, is being used in a research program to obtain data on the operation of fabric parachutes or other drag devices at supersonic speeds. (auth)

760 TID-6142
Kansas State Univ., Manhattan.
TABLES OF IONIZATION POTENTIALS. Robert W. Kiser. June 20, 1960. 209p. OTS.

A compilation is presented which represents a complete list of the ionization potentials of atoms, molecules, radicals, and ions. Methods of determination and literature references up to June 1960 are included. 566 references. (J.R.D.)

761 TID-6234(Rev.)
Tracerlab, Inc., Richmond, Calif.
THE EFFECTS OF INTENSE GAMMA IRRADIATION ON ELECTRIC BREAKDOWN IN HELIUM. Final Report Harlan C. Shaw. Mar. 18, 1960. 30p. For Kaiser Engineers Div. OTS.

The phenomenon of electric breakdown in gases is due primarily to the many parameters that influence breakdown to a major degree, such as gas constitution, temperature, pressure, density, shape and spacing of the electrodes, containing surfaces, type of applied voltage, and the nature of the external circuit. Experiments were carried out in the Experimental Gas Cooled Reactor (EGCR)

program which were designed specifically to determine the electric breakdown voltages of the contacts and the gross effects of intense gamma fluxes on these voltages. (W.D.M.)

762 TID-6678
Oak Ridge Gaseous Diffusion Plant, Tenn.
DIFFUSION OF RADIOACTIVE GASES THROUGH POWER REACTOR GRAPHITE. H. L. Weissberg and A. S. Berman. Apr. 6, 1959. 19p. Contract W-7405-eng-26. (KL-413). OTS.

Results of a study concerned with the problem of retarding the diffusion of fission products through unclad graphite fuel elements are presented. The pertinent parameters are pointed out, and their relations with the properties of graphite and gas coolants are considered. The effects of parameter variation on the concentration in the reactor primary system and the fission-product diffusion rate into the primary system are also examined. (J.R.D.)

763 UCRL-6121-T
California. Univ., Livermore. Lawrence Radiation Lab.
MAGNETIC CORE TESTS FOR PULSED OPERATION AT 30 NANOSECONDS PULSE WIDTH. Gilbert A. Reeser. Aug. 22, 1960. 16p. Contract W-7405-eng-48. OTS.

The magnetic properties of core materials were investigated for a pulse width of 30 nanoseconds. Methods of testing which are necessitated by the short pulse width are explained, and the design of the pulser which is capable of 0.2 Mw peak power is described. The data obtained are presented and evaluated for the various materials which were tested. (auth)

764 USNRDL-TR-434
Naval Radiological Defense Lab., San Francisco.
SOLAR RADIATION RECEIVING SURFACES FOR SATELLITE ELECTRICAL POWER GENERATORS. R. J. Jenkins. June 16, 1960. 15p.

A study was made of the optical characteristics required of a surface to convert solar radiant energy into sensible heat for a satellite electrical-generator system. It is shown that the absorptance for solar radiation of the surface should be high and is relatively of considerably more importance than the emittance of the surface for its own radiation. An optical system will be required to concentrate the solar energy on the generator if reasonable efficiencies are to be obtained. A heat-engine system compares unfavorably with photovoltaic cells for low-power electrical generators, but may be preferable for high-power generators. (auth)

765 JPRS-5279
NEWS OF HIGHER EDUCATIONAL INSTITUTIONS, MINISTRY OF HIGHER EDUCATION USSR. RADIOPHYSICS SERIES. Translation of Izvest. Vyshykh Ucheb. Zavedenii, Radiofiz. 2, No. 1, 3-146(1959). 319p. OTS.

Papers are presented on nonthermal cosmic radiation, formation of ionospheric inhomogeneities, magnetic bremsstrahlung, propagation of waves in magnetoactive plasma, action of noise on a generator with hard excitation, spectra of quasiperiodic random processes, theory of fluctuations in self-oscillating systems, energy losses of a charged particle passing through a periodically inhomogeneous dielectric, resonant phenomena in a system of continuously coupled lines, transverse electromagnetic waves in multiwire slow-wave systems, motion of electron beams in weakly inhomogeneous high-frequency fields, periodic interactions of electron streams, modified reflex klystron, pulse driving through a chain and ring of triggered multivibrators, surface electromagnetic waves in systems with inhomogeneous impedance, electronic control of triggered multivibrators, and stability of stationary modes in a simple power system. (W.D.M.)

766 NP-tr-480
THE NON-LINEAR CHARACTER OF CATHODIC SPUTTERING AT HIGH ENERGY AS A FUNCTION OF INTENSITY AND ITS VARIATION AS A FUNCTION OF TEMPERATURE. C. Cassignol and G. Ranc. Translated by F. Hudswell (U.K.A.E.A. Atomic Energy Research Establishment) from Compt. rend. 248, 1988-90(1959). 6p. JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 17202.

767
SELF-ABSORPTION OF THE 2537 Å RESONANCE RADIATION OF Hg. V. Vasiliu. Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz. 11, 443-7(1960). (In Rumanian)

The temperature dependence of the absorption of the 2537 A line of mercury passing through saturated mercury vapors at temperatures between 25 and 1000°C, corresponding to pressures ranging from 2×10^{-3} to 2×10^{5} mm of mercury, was studied by spectrographic and spectrophotometric measurements. The measured intensity of this line showed a rapid decrease with increasing temperature. A similar plot of the pressure variation as a function of temperature was found to be not completely symmetrical with the intensity vs. temperature curve thus indicating that the self-absorption is not due to the mercury vapor pressure alone but that other factors contribute to it. (TTT)

768
DETERMINATION OF THE MAGNETIC FIELD DISTRIBUTION BY MEANS OF MAGNETIC NUCLEAR RESONANCE. E. Gîldău and A. Valeriu. Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz. 11, 462-7(1960). (In Rumanian)

The magnetic field distribution cannot be determined with the required precision in small volumes of the sample by using the classical method based on emf measurements. Magnetic nuclear resonance was used with frequency modulation in order to avoid the difficulties caused by amplitude and phase variations between the center and the edge of the oscillograph screen. A simple device allowed the mobile sample to be displaced at constant angular velocities or at a constant radius in a plane parallel with the surface of the poles. The sample used contained 0.2 cc H_2O with 0.01 N $Fe(NO_3)_3$ in a Teflon capsule. Results indicated that the pole surfaces were not exactly parallel, although this fact could not be detected by micrometric methods within a limit of error of 5 μ. Further changes are planned on the apparatus on the basis of these measurements. (TTT)

769
NON-LINEAR EQUATIONS FOR SPINOR FIELDS. Jerzy Rayski (Inst. of Physics, Jagellonian Univ., Krakow). Acta Phys. Polon. 19, 409-11(1960). (In English)

A plausible form of a nonlinear spinor equation, similar to the equation of Heisenberg, is derived by using the principle of correspondence with general relativity. (auth)

770
CONTRIBUTION TO THE PHOTOGRAPHIC AND METHODOLOGICAL STUDY OF THE TRANSVERSE DIMENSIONS OF ION TRACKS IN IONOGRAPHIC EMULSIONS. APPLICATION TO THEIR DISCRIMINATION. Christiane Gégauff. Ann. phys. 5, 1027-84(1960) July-Aug. (In French)

The theoretical and practical problems on the measurement of the transverse dimensions of tracks of charged particles in emulsions are studied. The methodological problems relative to measurement procedures are first discussed. The study of tracks from the viewpoint of corpuscular photography (latent image and grain sensitivity) is based on the relationship between the distribution of the latent image in the AgBr grains and the energy spent by the different radiations. A theoretical study is made of the structure of the tracks, based on the spatial distribution of δ rays at all energies. The practical applications of the data obtained in these studies are then considered with emphasis on the possibilities of discriminating the particles by transverse measurement. (J.S.R.)

771

ON THE RELATIVISTIC PHOTOEFFECT IN THE K-SHELL. Bengt C. H. Nagel. Arkiv Fysik 18, 1-28(1960). (In English)

The relativistic K-shell photoeffect is analyzed in terms of four "reaction amplitudes," which describe the process completely, including all polarization effects. Expansions of these amplitudes in radial matrix elements are given. Using an improvement of the Sommerfeld-Maue final state wave function, the amplitudes are computed to relative order αZ for a pure Coulomb field. Among effects obtained from the first-order terms are a non-zero forward emission intensity and a transverse polarization of the photoelectrons similar to that obtained in relativistic electron scattering. (auth)

772

THE RELATIVISTIC PHOTOEFFECT AT THE K-SHELL THRESHOLD. Bengt C. H. Nagel and Per O. M. Olsson (Royal Inst. of Tech., Stockholm and Univ. of Stockholm). Arkiv Fysik 18, 29-35(1960). (In English)

The K-shell photoeffect is studied in the limit of zero kinetic energy of the outgoing photoelectron. The relativistic $(\alpha Z)^2$ corrections are obtained in the general case, and "exact" numerical calculations are performed for $Z = 92$. The total cross section is reduced by 21% (for $Z = 92$), and the angular distribution is changed, compared to the nonrelativistic results. Considerable electron polarization effects are obtained. (auth)

773

BOMBARDMENT OF METALS BY INERT GAS IONS. G. J. Ogilvie (Commonwealth Scientific and Industrial Research Organization, Melbourne). Australian J. Phys. 13, 402-7 (1960) July.

When the surface of a metal crystal is bombarded by inert gas ions, metal atoms are knocked off the surface in certain preferred directions. Evidence is presented to show that some atoms are also knocked into the crystal. A thin disoriented surface layer appears that, if the crystal is an alloy, is of uniform but different composition from that of the original crystal. The importance of these findings to some current ideas about damage due to bombardment is briefly discussed and it is shown that present theories do not account satisfactorily for the observations. (auth)

774

NEW PRINCIPLES OF ACCELERATION OF CHARGED PARTICLES. Teodor Toth. Automat. si Electron. 3, No. 2, 80-4(1959). (Translated from Referat Zhur. Fiz. No. 3, 1960, abstract No. 5114)

"Coherent" methods of accelerating particles to large energies are described, including acceleration by means of moving media, shock waves, and electromagnetic waves.

775

A PARALLEL INVESTIGATION OF DEPOLARIZATION AND ELECTROLUMINESCENCE OF ZnS PHOTOELECTRETS. V. M. Fridkin, A. N. Bogatyrev, and E. V. Brakhman (Inst. of Crystallography, Academy of Sciences, Moscow). Fiz. Tverdogo Tela 2, 2185-90(1960) Sept. (In Russian)

Previously described depolarization of ZnS photoelectrets by an alternating electric field was accompanied by ZnS electroluminescence. The described depolarization process was studied in order to determine the relation between the luminescence mechanism and depolarization. The experiments indicate that the depolarization process is not limited by self-luminosity and luminescence but may be induced by an "electric excitation" mechanism. A parallel investigation was made of the dependence of depolarization and electroluminescence intensity on the frequency and intensity of alternating fields. A drop in the dark polarization caused by an alternating field was also studied. (R.V.J.)

776

PHOTODIELECTRIC EFFECT IN THE Zn–CuS, CO PHOSPHORS. F. I. Vergunas and G. M. Malkin (Gor'kiĭ Inst. of Research in Physics and Tech., USSR). Fiz. Tverdogo Tela 2, 2322-9(1960) Sept. (In Russian)

Photodielectric effects in ZnS (Cu) phosphors at 200 to 5×10^4 Hz depend on the conductivity in granular specimens. The time of relaxation and the volume increment in a static field were studied as functions of temperature and intensity of the exciting light. (tr-auth)

777

METHOD OF LOCAL FUNCTIONS FOR THE PROBLEM OF ONE-DIMENSIONAL SCATTERING. [PART] II. Hoang Xuan Han (Société Alsthom, Paris). Inds. atomiques 4, No. 7-8, 63-70(1960). (In French)

The local flux function method for the solution of the problem of scattering for one and two groups, described in Inds. atomiques 4, 49(1960), is generalized. However, material difficulties limit it to the three-group theory. (tr-auth)

778

EFFECT OF HYDROGEN-ION BOMBARDMENT ON THE OXIDES OF ALUMINIUM AND MAGNESIUM. L. B. Griffiths (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature 188, 43(1960) Oct. 1.

Polycrystalline samples of aluminum and magnesium oxides were bombarded by hydrogen ions. Changes in electrical resistance were recorded. There was no sign of the observed effect becoming saturated within the time scale used. Subsequent to bombardment, the resistance returned to its original value. (M.C.G.)

779

PHOTOEMISSION AND VALENCE BAND STRUCTURE OF ALKALI IODIDES. H. Philipp, E. A. Taft, and L. Apker (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev. 120, 49-51(1960) Oct. 1.

Energy distributions are described for external photoelectrons ejected from CsI by photons of energy 11.3 ev. All but about 5% of the photoelectrons emerged with kinetic energies between 1.5 and 5.3 ev. The conspicuous lack of electrons at lower energies is interpreted in terms of a valence band of width about 3 or 4 ev, with an upper edge lying about 6 ev below the vacuum level. Related results are mentioned for RbI, KI, NaI, CsBr, and CsCl. (auth)

780

BROADENING OF THE MÖSSBAUER LINE. H. S. Snyder and G. C. Wick (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 120, 128-9(1960) Oct. 1.

The thermal excitation of the solid which leads to a temperature-dependent shift of the Mössbauer line could conceivably cause a broadening of this line. It is shown, through a quantum-mechanical treatment, that for a perfect crystalline solid such a broadening does not occur. (auth)

781

GRAVITATIONAL-ELECTROMAGNETIC COUPLING AND THE CLASSICAL SELF-ENERGY PROBLEM. R. Arnowitt (Syracuse Univ., New York), S. Deser, and C. W. Misner. Phys. Rev. 120, 313-20(1960) Oct. 1.

The gravitational effect on the classical Coulomb self-energy of a point charge was calculated rigorously. It is shown that the total mass then becomes finite (although still quite large), and that it depends only on the charge and not on the bare mechanical mass. Thus a particle acquires mass only when it has non-gravitational interactions with fields of nonzero range. In order to treat this problem, it was necessary to extend the canonical formalism, previously obtained for the free gravitational field, to include coupling with the Maxwell field and the point charge system. It is shown that the canonical variables of the gravitational field are unaltered while those of the matter system are natural generalizations of their flat space forms. The determination of the total energy of a state can still be made from knowledge of the spatial metric at a given time. The self-mass of a particle is then the total energy of a pure one-particle state, i.e., a state containing no excitations of the canonical variables of the Maxwell or Einstein fields. Solutions corresponding to pure particle states of two like charges were also obtained, and their energy is shown consistent with the one-particle results. (auth)

782

INTERIOR SCHWARZSCHILD SOLUTIONS AND INTERPRETATION OF SOURCE TERMS. R. Arnowitt, S. Deser, and C. W. Misner (Brandeis Univ., Waltham, Mass.). Phys. Rev. 120, 321-4(1960) Oct. 1.

The solutions of the Einstein field equations, previously used in deriving the self-energy of a point charge, are shown to be nonsingular in a canonical frame, except at the position of the particle. A distribution of "dust" of finite extension was examined as the model whose limit is the point particle. The standard "proper rest-mass density" was related to the bare rest-mass density. The lack of singularity of the initial metric $g_{\mu\nu}$ was in contrast to the Schwarzschild type singularity of standard coordinate systems. Solutions for the extended source were non-static in general, corresponding to the fact that a charged dust is not generally in equilibrium. However, the solutions became static in the point limit for all values of the bare-source parameters. Similarly, the self-stresses vanished for the point particle. Thus, a classical point electron is stable, the gravitational interaction cancelling the electrostatic self-force, without the need for any extraneous "cohesive" forces. (auth)

783

THERMAL EXPANSION COEFFICIENT OF SOLID He^3. Martin J. Klein and Raymond D. Mountain (Case Inst. of Tech., Cleveland). Phys. Rev. Letters 5, 363(1960) Oct. 15.

If the transition of solid He^3 from a nuclear antiferromagnet to a nuclear ferromagnet occurs at high pressure as previously predicted, then it should be accompanied by a change in the sign of the coefficient of thermal expansion. Since it was shown that the coefficient is negative at pressures of the order of the melting pressure and temperatures less than several tenths of a degree, it is concluded that there is a positive thermal expansion coefficient at pressures above 130 atm and temperatures above 0.1°K where the solid is ferromagnetic. (M.C.G.)

784

NUCLEAR POLARIZATION IN He^3 GAS INDUCED BY OPTICAL PUMPING AND DIPOLAR EXCHANGE. M. A. Bouchiat, T. R. Carver, and C. M. Varnum (Princeton Univ., N. J.). Phys. Rev. Letters 5, 373-5(1960) Oct. 15.

The Overhauser nuclear polarization effect involving dipolar interactions between an optically polarized atom and the nucleus of a suitable buffer gas was observed in He^3 gas used as the buffer for the optical pumping of rubidium vapor. The rubidium was polarized and the degree of nuclear polarization of He^3 was determined. The polarization was reduced by relaxation processes. The relaxation time was proportional to the density and doubled in going from 300 to 77°K. (M.C.G.)

785

THE VISCOSITY OF SUPERHEATED STEAM UP TO 270°C. J. Kestin and H. E. Wang (Brown Univ., Providence). Physica 26, 575-84(1960) Aug. (In English)

A series of measurements on the viscosity of superheated steam was obtained with the aid of an oscillating-disk viscometer. Measurements were made along the following four approximate isotherms: 136, 168, 198, and 234°C, from about atmospheric to saturation pressure. It is considered that the results are accurate to ±0.5%. The measurements show excellent agreement with an earlier series obtained by J. R. Moszynski, and the combined results were used to provide a tabulation for superheated steam up to 270°C. The extrapolated results for 1 atm show good agreement with the recent measurements of A. S. Shifrin. The results presented reveal an anomaly in that the pressure coefficient of viscosity is negative, decreasing with increasing temperature down to zero at 270°C. (auth)

786

ON THE TEMPERATURE DEPENDENCE OF THE PHOTOCONDUCTIVE DECAYTIME OF FILMS OF THE LEAD SALTS. F. M. Klaassen, J. Blok, H. C. Booy, and F. J. De Hoog (Vrije Universiteit, Amsterdam). Physica 26, 623-8 (1960) Aug. (In English)

Measurements were performed on the temperature dependence of the relaxation time of PbS photodetectors. The results were compared with a theoretical expression for relaxation times, following the kinetics of carrier transitions in semiconductors with trapping of minority carriers. Good agreement was found. From the results, the value of the energy depth of the trapping centers was found to be 0.165 ev. Moreover, it is concluded that the minority carriers are retrapped many times before recombination takes place. (auth)

787

CHARGE EXCHANGE, IONIZATION AND ELECTRON LOSS CROSS-SECTIONS OF Li IONS AND ATOMS OF 5 TO 22.5 keV IN H_2 AND He. J. Van Eck and J. Kistemaker (F.O.M.-Laboratorium voor Massaspectrografie, Amsterdam). Physica 26, 629-30(1960) Aug. (In English)

A monoenergetic beam of Li^+ ions containing 1 to 2% neutral atoms was directed on H_2 and He gases, and the inelastic cross sections for electron capture, ionization, and electron loss were determined by collecting on side electrodes the slow ions and electrons formed by the collision. The beam was 0.2 $\mu a/mm^2$ in intensity and its energy was varied from 5 to 22.5 kev. The results showed the expected gradual increase with energy. The total random error is less than 10%. (D.L.C.)

788

THE SECOND VIRIAL COEFFICIENT OF BINARY MIXTURES OF THE HYDROGEN ISOTOPES AND HELIUM AT

20.4°K. H. F. P. Knaap, M. Knoester, F. H. Varekamp, and J. J. M. Beenakker (Kamerlingh Onnes Laboratorium, Leiden). Physica 26, 633-7(1960) Aug. (In English)

The excess second virial coefficient, E, of binary mixtures of the hydrogen isotopes and helium was measured. E for a mixture of a hydrogen isotope with helium is quite large. There is reasonable agreement with the excess values derived from absolute measurements. For mixtures of the hydrogen isotopes, in agreement with theoretical predictions, no excess could be detected. (auth)

789

AN ACCURACY OF ONE MILLIONTH OF ONE BILLIONTH—THE LABORATORY VERIFICATION OF THE GENERAL THEORY OF RELATIVITY. V. V. Miller (Joint Inst. for Nuclear Research, Dubna, USSR). Priroda 49, No. 7, 7-12 (1960) June. (In Russian)

The recently materialized possibility of detecting the energy change of a gamma quanta moving in a gravity field is described. The change in wavelength to be detected is $1/10^{15}$ of the emitted wavelength. The development of theory and experiment in gamma ray resonance interactions is traced through the work of I. Ya. Barit and M. I. Podgoretskiĭ, of Pollard and Alburger, of Moon and Storrast, and finally of Mössbauer. The work of A. I. Alikhanov and V. A. Liubimov in measuring the magnetic moment of the Sn^{119} nucleus is described and suggested as the possible forerunner of experiments that will detect the gravity effect on gamma quanta energies. (TTT)

790

INVESTIGATION OF A RAREFIED GAS DEIONIZATION IN MAGNETIC FIELD. S. K. Guzhova and A. S. Syrgiĭ. Radiotekh i Elektron. 5, 1516-21(1960) Sept. (In Russian)

The rate of deionization in rarefied helium in uniform magnetic fields of 0 to 1300 gauss at 0.32 to 0.08 mm Hg was investigated. At ion concentrations less than 10^{10} cm^{-3}, the dependence of the transverse ambipolar diffusion coefficient on the magnetic field agrees with the Townsend formula. (tr-auth)

791

DEIONIZATION RATE OF A RAREFIED HELIUM IN MAGNETIC FIELD. PART II. A. S. Syrgiĭ and V. L. Granovskiĭ (Moscow State Univ.). Radiotekh i Elektron. 5, 1522-30(1960) Sept. (In Russian)

The participation of diffusion and volume recombination processes in the deionization of rarefied helium in 0 to 1500 gauss magnetic fields was evaluated by measuring the ion current at the wall and the initial number of charges in a plasma volume. Charge losses prevail at gas pressures of 10^{-2} to 10^{-1} mm Hg and carrier concentrations $\geq 10^{11}$ cm^{-3} in strong fields. The participation of volume recombination in charge losses increases with increased magnetic field and reduced pressure, reaching about 90% at p = 0.06 mm Hg and $n_e \simeq 5 \times 10^{11}$ cm^{-3}. (R.V.J.)

792

PREPARATION OF THIN NICKEL FILMS WITHOUT SUPPORT BY THERMAL EVAPORATION UNDER VACUUM. P. Prugne, P. Garin, and G. Lechauguette (Centre d'Études de l'Énergie Nucléaire, Saclay, France). Vide 13, 82(1958) Mar.-Apr. (In French)

The preparation of thin nickel films without support using the technique described in J. Phys. Radium 16, 740 (1955) but with a new evaporation apparatus is described. In order to obtain these nickel films, it was necessary to modify the thermal evaporation conditions. An attempt to obtain a film without support after evaporation in a conventional apparatus was almost always unsuccessful. This lack of success appeared to be caused by the high concentration of oxygen and various vapors in the residual atmosphere of the conventional evaporation system. The system used to overcome these difficulties is described. (tr-auth)

793

PROPAGATION OF SHOCK WAVES IN A GAS WITH INFINITE ELECTRIC CONDUCTIVITY AND A GRAVITATIONAL FIELD IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD. S. I. Pai. Z. angew. Math. u. Mech. 39, No. 1-2, 40-9(1959). (Translated from Referat. Zhur. Fiz. No. 4, 1960, abstract No. 7706)

The motion of a shock wave in a gas with infinite electric conductivity in the presence of a gravitational field and in a transverse magnetic field was investigated. Since the motion of the gas outside the shock wave was considered, the viscosity and the heat conduction were neglected, but the change in the entropy was taken into account. It is shown that in the case of strong shock waves, it is more convenient to use the Lagrange method rather than the Euler method when solving the problem. By means of a series expansion, within the framework of the Lagrange method, an approximate solution is obtained for a gas with a constant temperature in a constant magnetic field. Simultaneously, results of a numerical solution are given and the limit of applicability of the approximate solution is indicated. It was shown that the magnetic field produced an increase in the rate of propagation and an expansion of the region of influence of the shock wave. The course of the solution of the problem by the Euler method is briefly indicated.

794

SOME PROPERTIES OF STATIONARY FLOWS IN MAGNETIC GASODYNAMICS. K. B. Pavlov (Bauman Technical School, [USSR]). Zhur. Eksptl'. i Teoret. Fiz. 39, 304-7 (1960) Aug. (In Russian)

Stationary quasi-one-dimensional and one-dimensional flows are considered. It is shown that in the case of finite conducting media the formation of a shock wave is possible under certain conditions. (auth)

795

DEPENDENCE OF THE INELASTIC COLLISION CROSS SECTIONS OF ATOMS AND IONS ON VELOCITY IN THE CASE OF PSEUDO-INTERSECTION OF THE LEVELS. Yu. P. Mordvinov and O. B. Firsov. Zhur. Eksptl'. i Teoret. Fiz. 39, 427-31(1960) Aug. (In Russian)

The dependence of the inelastic collision cross sections for atoms and ions on their velocity is examined in the case of pseudo-intersection of the levels of the system of colliding particles. The time dependence of the electron wave functions is taken into account in terms of the radius vectors of the nuclei. The perturbation-matrix element in the Landau–Zener formula includes the usual stationary separation of the levels as well as a term which considers the indicated dependence of the electron wave functions on time. Under certain conditions the dependences of the cross sections on velocity may be curves with two peaks. (auth)

796

CONTRIBUTION TO THE THEORY OF SIMPLE MAGNETOHYDRODYNAMIC WAVES. R. V. Polovin (Inst. of Physics and Tech., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 463-70(1960) Aug. (In Russian)

The Riemann invariants are computed for simple magnetohydrodynamic waves. The change of velocity in fast and slow magnetoacoustic waves is determined for the case when the magnetic pressure in front of the wave is much smaller than the hydrostatic pressure. (auth)

797

INSTABILITY OF UNIFORM MAGNETIC PRECESSION. L. N. Bulaevskiĭ, V. M. Faĭn, and G. I. Freĭdman (Inst. of Radiophysics, Gor'kiĭ State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 39, 516-17(1960) Aug. (In Russian)

The appearance of nonuniform magnetization in systems with constant external magnetic fields results in a breakdown of uniform precession. It is postulated that uniform precession is unstable when small fluctuations induce increasing magnetic waves. The stability of uniform precession was studied in a series of ferromagnetic and ferrimagnetic alloys. (R.V.J.)

Astrophysics and Cosmology

798

COSMOGENIC NUCLEAR REACTIONS IN IRON METEORITES. D. E. Fisher and O. A. Schaeffer (Brookhaven National Lab., Upton, N. Y.). Geochim. et Cosmochim. Acta 20, 5-14(1960) Sept. (In English)

The cosmogenic He^3, He^4, Ne^{21}, Ne^{22}, Ar^{36}, and Ar^{38} isotopes were measured mass spectrometrically in seven ataxites and one octahedrite. An attempt at analysis of these and previous data is made based on nuclear reactions induced by high-energy protons. A combination of He^3/He^4, He^3/Ar^{38}, and Ne^{21}/Ar^{38} ratios are used as a measure of the energy and intensity of the incident radiation. Factors contributing to anomalous ratios are discussed. Exposure ages are deduced on the basis of these ratios, total isotopic abundances, and previously measured Cl^{36} values. (auth)

799

NUCLEAR REACTIONS IN THE STARS. E. Schatzman (Université, Paris). Inds. atomiques 4, No. 7-8, 41-51 (1960). (In French)

After a brief survey of astrophysical data, the basic processes in the production of energy in stars by the transformation of hydrogen into helium are examined. The principle evolution processes that lead to the transformation of dwarfs into giants are then described. The observation of the chemical composition of the stars necessitates the admission of the existence of some nuclear processes, reactions between α particles, or even between carbon nuclei. This explains the existence of carbonaceous stars or stars with rare earths. During their evolution the stars can become unstable, and pulsations or even explosions (novae) are then observed. The giant form of these explosions (supernovae) leads probably to the revival of natural radioisotopes in nature. (tr-auth)

800

THE DISTRIBUTION OF COSMIC-RAY-PRODUCED RARE GASES IN IRON METEORITES. P. Signer and A. O. Nier (Univ. of Minnesota, Minneapolis). J. Geophys. Research 65, 2947-64(1960) Sept.

The cosmogenic Ar^{38}, Ar^{36}, Ne^{22}, Ne^{21}, Ne^{20}, He^4, and He^3 distribution in part of a cross section of the iron meteorite Grant was measured. The amounts were found to vary systematically with depth. The depth effect was analyzed in terms of a production mechanism, and numerical parameters were determined. Comparisons were made with the results of other investigations. Functional relationships correlating relative amounts of cosmogenic nuclides with position and size of a meteoritic body are demonstrated. In principle the determination of a sufficient number of cosmogenic nuclides in a single sample permits deductions about the radiation dosage and the size of the meteoroid as well as the location of the sample within the body. (auth)

Cosmic Radiation

801 AD-235884

Boeing Scientific Research Labs., Seattle.

SHIELDING REQUIREMENTS FOR RADIATION BELT PARTICLES. J. C. Noyes and W. D. Brown. Jan. 1960. 28p. (D1-82-0048).

The proton energy spectrum in the heart of the inner radiation belt is presented, based on experimental data. The degraded spectra resulting from the attenuation of the incident protons by 5, 10, and 20 gm/cm^2 of polyethylene are calculated. The air dose rate due to the degraded protons is given as a function of polyethylene shielding thickness. Air dose rates range from 54 r/hr for no shielding to 2 r/hr for 20 gm/cm^2 shielding. The bremsstrahlung due to inner-belt electrons is estimated. The dose-rate contribution due to bremsstrahlung is considerably less than that due to protons. (auth)

802 INSJ-25

Tokyo Univ. Inst. for Nuclear Study.

COSMIC RADIATION OVER PRINCE ALBERT (THE ABSORPTION IN AIR AND THE TIME VARIATION). I. Mito. May 1, 1960. 36p.

The time variation of heavy cosmic-ray nuclei is discussed, summarizing the data from 1948 to 1960. In order to compare the data obtained at various altitudes, the absorption process was studied experimentally and analyzed on the basis of the optical model of nuclear reactions. The apparent fluctuation found in the previously published data is explained in terms of the 11-year variation. Energy dependence of absorption was studied at magnetic latitude 61°N after a large Forbush decrease. The dependence was found to be rather weak and was in favor of the model of geocentric modulation presented by Parker. (auth)

803

LOW-ENERGY SOLAR COSMIC RAYS AND THE GEOMAGNETIC STORM OF MAY 12, 1959. J. R. Winckler and P. D. Bhavsar (Univ. of Minnesota, Minneapolis). J. Geophys. Research 65, 2637-55(1960) Sept.

During a strong geomagnetic storm on May 11–12, 1959, and following a class 3+ chromospheric solar flare on May 10, a large intensity of low-energy solar cosmic-ray protons was observed in a balloon flight at 30-km altitude at Minneapolis, Minn. The results obtained with an ion chamber, a Geiger counter, and a scintillation counter are reported. The proton flux of energy above 100 Mev varied from 52 to 1.7/cm^2 · sec · steradian during the time 0400 to 1800 UT on May 12. The spectrum obtained with the counting instruments is consistent with detailed emulsion studies and has the form $N(>E) = CE^{-\gamma}$. With E in Mev, γ varied from 5 to 2 during the time period. The scintillation counter showed excess γ radiation from the nuclear effects of the cosmic-ray protons and intense bursts of auroral x rays, particularly at 0835 UT on May 12. The solar optical and radio features of the flare are discussed, and the relationship of the polar-cap ionospheric blackout to the Minneapolis measurements is considered. The cosmic-ray protons at Minneapolis are measured at energies well below the normal Störmer cutoff for that latitude. Several theories on this subject are presented. (auth)

804

OBSERVATIONS OF SOLAR COSMIC RAYS NEAR THE NORTH MAGNETIC POLE. K. A. Anderson and D. C. Enemark (State Univ. of Iowa, Iowa City). J. Geophys. Research 65, 2657-71(1960) Sept.

Following a large solar flare on July 16, 1959, fluxes of protons in the energy region 85 to 300 Mev in a steep spectral distribution were observed by means of high-altitude balloons over Resolute Bay, Canada. The flare particle intensity decreased rapidly and quite steadily over a period of several days, but on the occasion of the last flight, launched on July 27, a small flux remained above the high-energy cosmic-ray level. At that time the active region in which the flare occurred was nearly opposite central meridian. The time dependence of the particle intensity followed quite well a t^{-3} law for which t equaled zero about 16 hr after the flare. This low-energy cosmic-ray-producing flare was accompanied by large and complex radio-noise emission, and the particles produced the usual terrestrial effects of long-enduring polar-cap radio blackout, including large riometer effects. During the magnetic storm, at the time the particles were being admitted at forbidden geomagnetic latitudes to the south, the particle intensity was undisturbed over Resolute Bay. (auth)

805

COMPARISON OF SOLAR COSMIC RAYS INJECTION INCLUDING JULY 17, 1959 AND MAY 4, 1960. K. G. McCracken and R. A. R. Palmeira (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Research 65, 2673-83 (1960) Sept.

Using neutron monitor data obtained at high latitudes, it is shown that cosmic-ray particles of rigidity >1 bv were produced by the solar flare that occurred at 2115 UT on July 16, 1959. The exponent of the integral-rigidity spectrum of the radiation was ≤ -8.0. The temporal dependence of the flare radiation was unlike that of earlier flare effects, the intensity requiring ~7 hours to reach its maximum value. No impact zones were observed. Meson data obtained at the time of the flare effect starting at 1031 UT on May 4, 1960, are presented. By considering the abovementioned flare effects, and those observed previously, it is shown that the time scale of the cosmic-ray flare effect is a highly variable quantity, varying by a factor as great as 36 from event to event. The flares responsible for the four flare effects with the shortest time scales occurred on the western solar limb; those resulting in the flare effects with the longest time scales occurred near the center of the solar disk. These facts are shown to support the theoretical model proposed by Piddington. (auth)

806

OBSERVATIONS OF SOLAR FLARE RADIATION AND MODULATION EFFECTS AT BALLOON ALTITUDES, JULY 1959. A. Ehmert (Max-Planck-Institut für Aeronomie, Lindau a. Harz, Ger.), H. Erbe, G. Pfotzer, C. D. Anger, and R. R. Brown. J. Geophys. Research 65, 2685-94(1960) Sept.

Observations of cosmic-ray time variations in the stratosphere were obtained over Berkeley, Calif. (USA), and Lindau/Harz (Germany) during the period of outstanding solar activity in July 1959. Whereas over Berkeley (geomagnetic latitude 44°N) only modulation of cosmic radiation by solar-controlled processes was observed, additional radiation accelerated in the vicinity of the sun (approximately 46% above normal) was observed over Lindau (geomagnetic latitude 52°N) on July 15. On the assumption that the excess radiation consisted almost entirely of protons, its energy spectrum had the form $N(E)dE \sim E^{-4}$ dE and extended up to 400 Mev. According to conventional geomagnetic theory, individual protons of these energies are normally forbidden at geomagnetic latitude 52°N. Their presence over Lindau on July 15 indicates that they were admitted by some mechanism which temporarily lowers the cutoff rigidity at this latitude during a magnetic storm. There is some indication of further examples of excess radiation over Lindau at atmospheric depths down to 30 mm Hg on July 13, 21, 23, and 31. (auth)

807

DEVELOPMENT OF MULTIPLE RADIATION ZONES ON OCTOBER 18, 1959. B. J. O'Brien and George H. Ludwig (State Univ. of Iowa, Iowa City). J. Geophys. Research 65, 2695-9(1960) Sept.

Data from two Geiger counters on Explorer VII indicate that anomalous radiation zones developed around 1000-km altitude on the low-latitude side of the outer radiation zone during a moderate magnetic storm on Oct. 18, 1959. The zones were first detected as quite separate regions of increased counting rates, each region about 0.5° thick in latitude. Later, other narrow zones were seen to be superimposed on a 6°-thick zone of steadily increasing intensity. At one time, this broad zone contained radiation even more intense than that in the normal outer zone. The anomalous radiation disappeared within a few days as the outer zone returned to its prestorm condition. Correlation with ionospheric data indicates that much of the detected radiation was trapped for some hours at least. A qualitative explanation of the phenomena is suggested. (auth)

808

CALCULATIONS OF COSMIC-RAY TRAJECTORIES NEAR THE EQUATOR. Paul J. Kellogg (Univ. of Minnesota, Minneapolis). J. Geophys. Research 65, 2701-3(1960) Sept.

New calculations of cutoff rigidities near the equator were carried out on a fast electronic computer, using the 48-parameter expression for the earth's magnetic field. The results are in good accord with observations. (auth)

809

ELECTRONS OF THE VAN ALLEN RADIATION. Paul J. Kellogg (Univ. of Minnesota, Minneapolis). J. Geophys. Research 65, 2705-13(1960) Sept.

Calculations are presented for the flux of trapped electrons to be expected on the hypothesis that these electrons are β decay electrons from neutrons produced in the atmosphere by cosmic rays. It is shown that such electrons can form only a very small part of the observed electron component even in the inner zone. The observed energy spectrum is shown to be different from that expected from neutron β decay, and so other sources of neutrons are not worth considering. It is concluded that the observed electrons are most probably accelerated in place by high-frequency electromagnetic fields. (auth)

810

DIRECT MEASUREMENT OF PARTICLES PRODUCING VISIBLE AURORAS. Carl E. McIlwain (State Univ. of Iowa, Iowa City). J. Geophys. Research 65, 2727-47(1960) Sept.

The nature of particles producing two visible auroras at Fort Churchill, Canada, was determined with the aid of rocket-borne detectors. Magnetic fields were used to separate the proton and electron components of the particle flux. It was found in each case that a major fraction of the auroral light was produced by electrons with energies of less than 10 kev. IGY rocket II6.26F was fired into a quiescent auroral glow of about intensity I. The integral number energy spectrum of protons incident upon the atmosphere during this flight was measured to be approximately $2.5 \times 10^6 \exp(-E/30)$ protons/sec cm^2 ster at 80 to 250 kev, where E is the proton energy in kev. The observed altitude dependence of the electron energy flux could have

been produced by an integral number energy spectrum equal to $2.5 \times 10^9 \exp(-E/5)$ electrons/sec cm^2 ster at 3 to 30 kev. IGY rocket II6.27F was fired into a bright active auroral arc. At least 75% of the light in this aurora was produced by nearly monoenergetic electrons with about 6-kev energy. The electron flux varied rapidly with time; peak values were about 5×10^{10} electrons /sec cm^2 ster. The presence of monoenergetic electrons strongly suggests an electrostatic acceleration mechanism. (auth)

811

OUTER RADIATION BELT AND SOLAR PROTON OBSERVATIONS WITH EXPLORER VII DURING MARCH–APRIL 1960. James A. Van Allen and Wei Ching Lin (State Univ. of Iowa, Iowa City). J. Geophys. Research 65, 2998-3003(1960) Sept.

Explorer VII was launched Oct. 13, 1959. It contained an instrument to observe the lower parts of the inner and outer radiation belts, the primary cosmic-ray intensity near the earth, and the arrival of solar protons. A summary of the properties of the two Geiger detectors in the instrument is tabulated. All data were derived from receptions at Iowa City, Iowa; Bloom Point, Md; and Woomera, Australia. The data presented represent the period from the latter part of March to mid-April 1960. The data are published in advance of a more comprehensive survey because of the geophysical events of interest during this period and because of the support of the observations with Pioneer V for the same period. Sequences of representative observations are illustrated as apparent count rate as a function of universal time. (B.O.G.)

812

SOLAR COSMIC RAYS AND SOFT RADIATION OBSERVED AT 5,000,000 KILOMETERS FROM EARTH. R. L. Arnoldy, R. A. Hoffman, and J. R. Winckler (Univ. of Minnesota, Minneapolis). J. Geophys. Research 65, 3004-7(1960) Sept.

During the period Mar. 27 to Apr. 6, 1960, the integrating ionization chamber and Geiger counter in Pioneer V detected solar cosmic rays and some soft-radiation effects associated with a high level of solar activity. The space probe was 5×10^6 km from the earth, approximately in the plane of the ecliptic, and located somewhat behind the sun-earth radius toward the sun. The solar activity was associated with McMath plage region 5615 and was characterized by numerous flares of all sizes, large loops and surge prominences, and strong emission over a wide range of frequencies. On Mar. 31 at 0800 UT, a severe geomagnetic storm began on earth accompanied by major earth-current disturbances, a complete blackout of the North Atlantic communications channel, and auroral displays. At the same time, a large Forbush decrease occurred in the galactic cosmic radiation. An intense series of balloon flights was conducted to record the counting-rate increases at high altitudes due to solar cosmic rays and auroral x rays. Explorer VII showed substantial changes in the radiation belts and detected the solar cosmic rays. The observations of Pioneer V are summarized and compared to the findings of Explorer VII for the same period. (B.O.G.)

813

THE EFFECT OF THE INITIAL PHASE OF A MAGNETIC STORM UPON THE OUTER VAN ALLEN BELT. J. M. Malville (Univ. of Colorado, Boulder). J. Geophys. Research 65, 3008-10(1960) Sept.

The results are given for calculations of the longitudinal invariant of the motion of charged particles trapped in a magnetic dipole field and a compressed dipole field. The variation of the longitudinal invariant with the latitude of intersection of the line of force with the earth's surface between 50° and 80° was calculated for a dipole field and for a field compressed by an image dipole at a distance 2Z from the dipole axis (Z being the distance from the axis to the front of the charged plane). The results of the calculation are shown graphically to a mirror height of 1000 km. The magnetic field strength is given as a function of the elevation of the mirror point. (B.O.G.)

814

INCREASE OF THE NUCLEONIC INTENSITY ON MAY 4, 1960. J. H. Trainor, M. A. Shea, and J. A. Lockwood (Univ. of New Hampshire, Durham). J. Geophys. Research 65, 3011-12(1960) Sept.

An increase in cosmic-ray intensity at the earth was observed on May 4, 1960, ~16 min after a class 2 solar flare. The increase was very rapid and was recorded only at certain stations within well-defined regions. The observations reported were made at Mt. Washington (elevation 1909 m) and Durham, N. H. (sea level). Some tentative conclusions are given concerning the rigidity spectra of the flare-produced particles. The cosmic-ray intensity increase started at 1031.5 ± 1.0 UT and reached a maximum increase of 214% between 1040 and 1042, falling to 18% at 1125 to 1130. At 1830 to 1930, the intensity was still ~2.4% above the preincrease level. The nucleonic intensity increase was about 20% below that in 1954. A plot of the 12-hr average neutron intensity as percentage change from the average of Apr. 25 to May 4, 1960, shows that the intensity was recovering from a series of Forbush events. None of these events appeared to be associated with the region which produced the cosmic-ray increase. (B.O.G.)

815

COSMIC RAY EVENT OF MAY 4, 1960. J. Hladký, J. Kleczek, L. Křivský, and P. Mokrý (Inst. of Physics, Czechoslovak Academy of Sciences, Prague and Inst. of Astronomy, Czechoslovak Academy of Sciences, Ondřejov). Nuovo cimento (10), 17, 610(1960) Aug. 16. (In English)

An increase in the nucleonic component of cosmic rays was recorded at Prague on May 4, 1960. The same event was also observed at the polar station Ellsworth and at the mountain station Lomnický štít. The only possible solar phenomenon with which to correlate this event appeared to be the development of a system of loop prominences in the coronal region above the sunspot group on that date. (M.C.G.)

816

ENERGY DETERMINATION OF HEAVY PRIMARIES IN NUCLEAR EMULSION. P. L. Jain (Univ. of Chicago). Phys. Rev. 120, 293-300(1960) Oct. 1.

The "knock-on electron" method was used to determine the energy per nucleon of the heavy primary particle. In this method, the energy of the primary particle was determined by measuring the emission angle and the energy of the knock-on electrons. The conditions for the reliable estimate of the primary energy by this method are discussed. This method was applied to 34 flat events, of primary energy between 3 and 30 Bev/nucleon and of charge $Z > 4$, which made nuclear interactions and broke up into two or more α particles. The energy of the primary particle obtained by knock-on electron method was then compared with the energy obtained by opening angle of α particles and by relative scattering measurements of α particles. The results obtained by the knock-on electron method were quite consistent, within the experimental error, with the results obtained by other methods. (auth)

817

A CRITICAL APPRAISAL OF SOME COSMIC RAY DATA FOR THE I.G.Y. R. P. Kane (Physical Research Lab.,

Ahmedabad, India). Proc. Indian Acad. Sci., Sec. A 52, 69-79(1960) Aug. (In English)

Cosmic-ray recordings were made with comparable instruments at stations where similar responses to primary variations of intensity were expected. Discrepancies of the order of a few per cent are sometimes observed. The discrepancies are often too large to be explained either on the basis of statistical errors or through the application of improper meteorological corrections. The order of magnitude of the discrepancies in intensity averaged on a 2-, 6-, and 24-hour basis is evaluated. The validity of drawing conclusions of physical significance from the International Geophysical Year data under various conditions is discussed. The importance of applying appropriate statistical tests to available data is emphasized. (auth)

818

COSMIC RAYS AND COSMIC SPACE. S. N. Vernova. Vestnik Akad. Nauk S.S.S.R. 30, 10-26(1960) Aug. (In Russian)

An account is given of recent studies of cosmic rays utilizing both earthbound stations and artificial earth satellites. Phenomena recently uncovered by sputniks are described. A description is given of the cosmic ray laboratory of Moscow University. A particle possessing an energy of 10^{15} ev was detected and the equipment and procedure by which this was done are described. μ mesons in a particle shower produced by cosmic rays were detected at a depth of thirty meters underground. The apparatus required in the sputniks for the study of cosmic rays outside the earth's atmosphere is discussed. The equipment in the sputniks launched to date was transistorized; scintillation counters were used to determine particle energies. A description is given of the large burst of radiation detected by the second sputnik on Nov. 7, 1957. This burst was observed only at latitudes of about 50 to 70 degrees north latitude. The third sputnik had a scintillation counter of high sensitivity which detected relatively weak fluxes of electrons. This equipment fixed the location of the high intensity radiation belt around the earth. A typical graph of count rate and energy current versus geographic location is given. Data are given that indicate the coincidence of peak radiation intensities with those regions where the aurora borealis is seen. The radiation belt extends up to approximately 60,000 km from the earth's surface and is bounded by the magnetic lines of force that intersect the earth's surface at geomagnetic latitudes of 55° and 70°. The earth's magnetic field traps these particles and holds them in an orbit that follows magnetic lines of force and oscillates from the northern to the southern hemisphere for long periods of time. A diagram is given of the trajectory of the first Soviet cosmic rocket and changes in radiation intensity along this trajectory are indicated. A maximum radiation intensity was detected at a distance of 20,000 km from the earth's surface. A diagram compares the data of the first and second Soviet cosmic rockets. It is indicated that radiation intensity in the outer belt varies with time due to variation of emanations from the sun. The energy spectrum of radiation in the outer belt was obtained with gas discharge and scintillation counters installed behind varying amounts of lead, copper, and aluminum shielding. Results are given in a diagram of particle and energy flux versus distance from the earth. The conclusion is reached that the outer radiation belt consists of electrons whose energies vary over six orders of magnitude. However the data from the second rocket indicated that the upper limit of electron energies appears to be 5 Mev. The electron flux is highest at an energy of about 1 Mev. It is pointed out that in the outer radiation belt the energy density of radiation approaches its maximum possible value, that is, the energy density of the earth's magnetic field at that distance. A discussion is given of the inner radiation belt, first described by Van Allen. No evidence of radiation belts about the moon was found. A discussion of the possible origins of the outer radiation belt of the earth and of other radiation belts and magnetic fields in space is given. In the study of solar flares, 1500 radiosonde balloon flights were made during the IGY. These flights established that solar flares are an extreme hazard for space travelers. (TTT)

819

COSMIC RAYS FROM THE SUN. A. N. Charakhch'yan, V. F. Tulinov, and T. N. Charakhch'yan (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz. 39, 249-56(1960) Aug. (In Russian)

A number of cosmic-ray flares were observed in the stratosphere at a geomagnetic latitude of 64°. The flares are due to 100 to 200 Mev protons. These intensity bursts were preceded by solar-chromosphere flares which are the source of the protons of the indicated energies. It is suggested that these protons are carried by solar corpuscular beams with magnetic fields frozen inside them. (auth)

820

TRANSVERSE MOMENTUM COMPONENT OF STRANGE PARTICLES PRODUCED IN PENETRATING COSMIC RAY SHOWERS. E. L. Andronikashvili and N. N. Roĭnishvili (Inst. of Physics, Academy of Sciences, Georgian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 267-70(1960) Aug. (In Russian)

Results of measurement of the transverse momenta of strange particles produced by the cosmic radiation are presented. It is shown that the mean value of the transverse momentum of heavy unstable particles is (0.52 ± 0.06) Bev/c. Within the limits of experimental errors it is independent of the type of strange particle and energy of the primary particle in the interval $(1 \div 10) \cdot 10^{10}$ev. (auth)

821

OBSERVATION OF μ-MESON BURSTS IN A SET OF IONIZATION CHAMBERS. N. N. Goryunov and G. T. Zatsepin. Zhur. Eksptl'. i Teoret. Fiz. 39, 271-5(1960) Aug. (In Russian)

Bursts due to high energy ($E \geq 10^{11}$ ev) μ^- mesons moving at a small angle to the horizontal surface were observed in a set of cubic ionization chambers. It is shown that, with a set of ionization chambers similar to that described in the paper but somewhat modified, it should be possible to study the angular distributions of high energy μ mesons. (auth)

822

ON THE ORIGIN OF THE PARTICLE BEAM IN THE AIR SHOWER CORE. S. N. Vernov, I. P. Ivanenko, G. V. Kulikov, and G. B. Khristiansen (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 39, 509-12(1960) Aug. (In Russian)

Narrow beams consisting of 4 to 15 particles with colinear trajectories were found in diffusion-chamber studies of wide atmospheric shower cores. On the basis of the experimental data it was postulated that the narrow beam was either an electron-photon shower formed by a π^0 meson or a group of high energy μ mesons. It is shown that the latter assumption is the more probable. (R.V.J.)

Elementary Particles and Radiations

823 AFOSR-TN-60-710

Vienna. Universität. Institut für Theoretische Physik. THE TWO MESON APPROXIMATION FOR THE REAL NU-

CLEON. Scientific Note No. 3. G. Eder. May 24, 1960. 14p. Contract [AF]61(052)-265.

The method of momenta proposed by Halpern is applied to the description of the real nucleon state in the two-meson approximation. The static model of Chew and Low for an extended source was used. It seems possible to get a weakly coupled model which gives a good value of f^2 and which fits rather well the sum rules for the pion-nucleon scattering amplitudes. (auth)

824 AFOSR-TN-60-1081

Cambridge Univ., England.

LOW ENERGY PION SCATTERING. Technical Scientific Note No. 9. J. Hamilton and T. D. Spearman. June 1960. 39p. Contract AF61(052)-233.

Partial wave dispersion relations are used to investigate low-energy s-wave pion-nucleon scattering. The various terms in the relations are examined. It is shown that the Born terms are very small and the remaining terms are of the same order of magnitude as the observed scattering amplitudes. The evidence for a low-energy pion-pion interaction from s-wave pion-nucleon scattering is examined. A comparison of the dispersion relations for s- and p-wave partial amplitudes is made. (auth)

825 CRNP-948

Atomic Energy of Canada Ltd., Chalk River, Ont.

ENERGY DISTRIBUTIONS OF NEUTRONS SCATTERED FROM GRAPHITE, LIGHT AND HEAVY WATER, ICE, ZIRCONIUM HYDRIDE, LITHIUM HYDRIDE, SODIUM HYDRIDE AND AMMONIUM CHLORIDE BY THE BERYLLIUM DETECTOR METHOD. A. D. B. Woods, B. N. Brockhouse, M. Sakamoto, and R. N. Sinclair. Sept. 12, 1960. 23p. (AECL-1088). AECL.

For presentation as paper No. 15/A/22 at the Symposium on Inelastic Scattering of Neutrons in Solids and Liquids, Vienna, October 11-14, 1960.

Energy distributions of neutrons scattered from various moderators and from several hydrogenous substances were measured at energy transfers of 0.02 to 0.24 ev. Results from experiments on graphite, light and heavy water, ice, ZrH, LiH, NaH, and NH_4Cl are included. It is noted that the results are of a preliminary character; however, they are probably the most accurate measurements of high-energy transfers yet made. (J.R.D.)

826 DTMB-AML-103

David Taylor Model Basin. Applied Mathematics Lab., Carderock, Md.

MULTIGROUP TRANSPORT CODE RDR 5. Charles Dawson. May 1960. 38p.

A description of RDR 5, a multigroup slab-geometry neutron-transport code for the NORC computer, is given. The code features anisotropic scattering, up to 99 lethargy groups, and a 10-point discrete ordinate approximation to the angular dependence of the vector flux. The equations used in the code are derived, and the input for the code is described. (auth)

827 GA-1584

General Atomic Div., General Dynamics Corp., San Diego, Calif.

A PRELIMINARY REPORT ON MEASUREMENTS OF DIFFUSION PARAMETERS IN WATER BY THE PULSED-NEUTRON METHOD. W. M. Lopez, J. R. Beyster, R. E. Nather, and J. L. Wood. Sept. 15, 1960. 20p. Project No. 48.01. Contract AT(04-3)-167. OTS.

The substance of this paper was given in a talk at the American Nuclear Society Meeting in Chicago, June 15, 1960.

A 25-Mev electron linac, capable of producing 2×10^{10} n/pulse by the (γ,n) process in water-cooled lead or tungsten-alloy targets, was used to study neutron diffusion parameters in water. The detector used in the measurements was a small fission counter 0.25 in. in diameter and 0.5 in. long with a 1 mg/cm^2 coating of U^{235} on the outer electrode. Perturbation effect was determined by comparing the measured decay with the detector in the center to that measured with the detector on the surface. (W.D.M.)

828 GA-1689

General Atomic Div., General Dynamics Corp., San Diego, Calif.

SLOW NEUTRON INELASTIC SCATTERING AND NEUTRON THERMALIZATION. Mark Nelkin. Sept. 23, 1960. 48p. Project No. 48.01. Contract AT-04-3-167. OTS.

The theory of slow-neutron inelastic scattering is reviewed. The time-dependent formalism is presented, and the development of short collision-time approximations is given in some detail. Emphasis is placed on the constraints obeyed by the scattering law independent of the details of the scattering system. The theory of neutron thermalization is reviewed, and the features of the scattering law most relevant to the thermalization process are indicated. Specific calculations of the energy-transfer cross sections for graphite are discussed. A simple proof of the fluctuation-dissipation theorem for the density fluctuations is given, and the result is applied to the short time behavior of the atomic motions at high temperatures. (auth)

829 NP-9216

Bordeaux. Université. Faculté des Sciences and Paris. Université, Orsay. Ecole Normale Supérieure. Faculté des Sciences.

RELATIVISTIC DEUTERON WAVE FUNCTION. [PART] II. Technical Note No. 19. M. Gourdin and J. Tran Thanh Van. [1959?]. 22p. Contract AF61(052)-173.

Bethe and Salpeter's relativistic wave equation was applied to the bound system of two particles with spin $\frac{1}{2}$. After some very slight approximations, the solution of the infinite system of coupled integral equations enables us to find the explicit structure of the wave matrices corresponding to the S and D states. The percentage of D state obtained is in good agreement with the experimental result. (auth)

830 TID-6699

Maryland. Univ., College Park.

(Σ^0,Λ^0) RELATIVE PARITY AND THE DALITZ DECAY OF THE Σ^0 HYPERON. Technical Report No. 188. J. Sucher and G. A. Snow. July 1960. 7p. Contract AF49(638)-24. (AFOSR-TN-60-853). OTS.

It has been shown that the branching ratio of the Dalitz decay, $\Sigma^0 \rightarrow \Lambda^0 + e^+ + e^-$, to the ordinary decay, $\Sigma^0 \rightarrow \Lambda^0 + \gamma$, depends on the value of the (Σ^0,Λ^0) relative parity, being 1/84 for even and 1/165 for odd relative parity. It is pointed out that if a reaction can be found in which polarized Σ^0 hyperons are produced, then the angular correlation between the spin of the Λ^0 and the plane of the electron-positron pair in the Dalitz decay is very sensitive to the value of the relative parity. The spin direction of Λ^0 may be determined from the asymmetry in the angular distribution of the decay pion from $\Lambda^0 \rightarrow p + \pi^-$. (W.D.M.)

831 UCRL-6083

California. Univ., Livermore. Lawrence Radiation Lab.

MEASUREMENT OF THE TEMPERATURE DEPENDENCE OF NEUTRON DIFFUSION PROPERTIES IN BERYLLIUM USING A PULSED NEUTRON TECHNIQUE (thesis). Warren M. Andrews. Aug. 1960. 240p. Contract W-7405-eng-48. OTS.

The pulsed-neutron technique was used to measure the temperature dependence of neutron-diffusion properties in beryllium. Essentially the pulsed technique consists in (1) introducing a short pulse of neutrons into a volume of the material under study, (2) waiting long enough for the neutrons to thermalize and reach a normal mode distribution, and (3) measuring the decay rate of the normal-mode density distribution. The decay constant is a function of the neutron absorption in the material and leakage from the volume. The leakage is modified by the diffusion-cooling effect; this effect is due to a preferential leakage of higher energy neutrons which leaves the equilibrium distribution "cooled" below that which would exist in an infinite medium. Experimentally, the decay constant is measured for a series of buckling values and then the decay constant vs. buckling data are fitted to a quadratic expression in terms of the buckling. The values of the absorption cross section, the diffusion coefficient, and the diffusion cooling coefficient are obtained from this. In the case of temperature-dependent measurements, the decay constant is measured for each buckling value at a series of specified temperatures and the decay constant vs. buckling data are analyzed at each temperature. Thus the values of the neutron-diffusion parameters are obtained at each of the temperatures investigated. Both Van de Graaff and Cockcroft-Walton accelerators were used as sources of pulsed neutrons. The time analyzer was a 256-channel pulse-height analyzer converted to a time-base analyzer. Two Li^6I detectors were used to measure the decay of the neutron density. The high-temperature facility was a closed-cycle forced-hot-air system. The temperature range investigated was 292 to 478°K. The value of the absorption cross section of the high-purity commercial-grade beryllium used was found to be about 10 mb. At room temperature the value of the diffusion coefficient was found to be 0.50 cm. With increasing temperature the value of the diffusion coefficient decreased about 6%. The value of the diffusion-cooling coefficient was found to be 2.3 cm^2 at room temperature, decreasing to a value of 1.4 cm^2 with an increase in temperature. A study of the time necessary after a pulse for the normal mode to be established is discussed. It was found that this time is independent of the relative source-detector position for an externally located source. (auth)

832 UCRL-6108-T

California. Univ., Livermore. Lawrence Radiation Lab. ANALYSIS OF NUCLEON-NUCLEON SCATTERING EXPERIMENTS. H. Pierre Noyes. Aug. 1960. 32p. Contract W-7405-eng-48. OTS.

Presented at session S-1 of the Tenth Annual International Conference on High-Energy Physics, Rochester, New York, August 25–September 1, 1960.

The analysis of the latest experiments on p-p scattering at 210 Mev makes it probable that there is a unique set of phase shifts at this energy. Under reasonable assumptions about continuity of the phase shifts and the behavior of the higher partial waves, it is possible to pick a unique solution also at 310 and 95 Mev. This opens a new era in the analysis of nucleon-nucleon scattering, which should lead to a unique model for the scattering matrix up to 400 Mev. Theoretical attempts to calculate a "meson potential" from field theory have not been successful, and the semi-phenomenological potential models, although now in good qualitative agreement with experiment, are not quantitatively reliable. Instead of using these models as a basis for an energy-dependent parameterization of the scattering matrix, as was done by Breit and his collaborators, it is here argued that the Mandelstam representation offers a more reliable starting point. A formalism is developed which allows the one and two pion exchange interaction to be included exactly and gives a Lorentz-invariant description of the rest of the interaction. Coulomb effects are included in single pion exchange, and it is shown that the $^1S_0$ n-p and p-p states are charge independent within the region of the remaining theoretical uncertainties. A new analysis is presented of n-p total cross sections between 1 and 14 Mev which obtains a value of 2.67 ± 0.03 for the singlet effective range, in good agreement with the theoretical prediction. Results of an energy-dependent analysis of 387 pieces of p-p data reported elsewhere are examined from the point of view of the Mandelstam representation. The parameters which fit the $^1S_0$ state are inconsistent with the theory if the interaction cut is replaced by four poles. Including single pion exchange as a continuous cut and representing multiparticle exchanges by poles gives a theoretically consistent model for this state. (auth)

833 UCRL-9380

California. Univ., Berkeley. Lawrence Radiation Lab. THE EARLY ANTIPROTON WORK. Owen Chamberlain. Dec. 15, 1959. 34p. Contract W-7405-eng-48. OTS.

Early work on the antiproton, particularly that part which led to the first paper on the subject, is described. Conclusions that can be drawn purely from the existence of the antiproton are discussed. (W.D.M.)

834

CONSIDERATION OF THE THEORY OF ELEMENTARY PARTICLES. C. THEORY OF FUSION OF ELEMENTARY PARTICLES AND HEISENBERG'S RESEARCH ON THE UNIFIED THEORY OF ELEMENTARY PARTICLES. Teofil T. Vescan. Acad. rep. populare Romîne, Filiala Iaşi, Studii cercetări ştiinţ., fiz. ştiinţe technice 9, No. 2, 205-14(1958). (Translated from Referat. Zhur. Fiz. No. 3, 1960, abstract No. 5088)

The de Broglie theory of fusion (de Broglie, L., Theorie generale des particules a spin, Paris, 1943) is developed. Recalling in this connection the Heisenberg nonlinear theory, the relation of these two theories is emphasized.

835

BREMSSTRAHLUNG IN THE SECOND BORN APPROXIMATION. P. Urban. Acta Phys. Austriaca 13, 496-505 (1960). (In German)

The differential cross section for bremsstrahlung in the second Born approximation was obtained by assumption of a screened Coulomb potential. Because of the complexity of the formulas the limiting case of small irradiated quanta is discussed. A term erroneously omitted in an earlier investigation is considered, and it is shown that its effect cannot be neglected directly. The occurrence of certain integrals makes the discussion of the various limiting cases difficult. The various types of these integrals are classified and reduced to knowns. (tr-auth)

836

THE STATISTICAL ERROR IN X-RAY ABSORPTION MEASUREMENTS. Bertil Nordfors (Univ. of Uppsala). Arkiv Fysik 18, 37-47(1960). (In English)

The statistical error in the determination of x-ray absorption coefficients is studied for the case of counter registeration. Optimum conditions are found for the absorber thickness and for the time distribution between measuring I_0 and I. The influence of background radiation is discussed, and a table giving the optimum conditions for different backgrounds is appended. (auth)

837

A PULSE METHOD OF MEASURING THE AGE OF NEUTRONS IN GRAPHITE. Z. Dlougy. Atomnaya Energ. 9, 182-8(1960) Sept. (In Russian)

The age of thermal neutrons from D–D and D–T reactions was measured in graphite. The thermal neutron density as a function of time was used for estimating the effective age of D–D neutrons, $\tau_{eff} = 355 \pm 9$ cm^2, for a graphite density of 1.6 g/cm^3. The slowing down of D–T neutrons in graphite is expressed by two neutron groups: neutrons that experienced only one inelastic interaction ($\tau_{eff} = 600$ cm^2) and neutrons experiencing several inelastic interactions ($\tau_{eff} = 240$ cm^2). In determining the age τ, the relative contributions of both groups were considered to be 0.65 and 0.25, respectively. A third group consisted of neutrons slowed down by elastic interactions only; the contribution (0.1) and age of the third group were very small and were not considered in the initial approximation. (tr-auth)

838

SOME CONSEQUENCES OF NEUTRON RESONANCE. J. E. Lynn. Endeavour 19, 215-22(1960) Oct.

The interpretation of absorption spectra in terms of quantized transitions of the atom from one energy state to another is now generally understood. More recent, and less familiar, is the discovery of an analogous interaction between a neutron, behaving as though it were a wave, and an atomic nucleus. A review is given of some of the consequences, both theoretical and practical, of resonance between the nucleus and neutron waves. (auth)

839

THERMAL DIFFUSION LENGTH MEASUREMENTS ON GRAPHITE IMPREGNATED BY DIPHENYL. R. Bonalumi (Centro Informazioni Studi Esperienze, Milan), S. Bruschetti, C. Bruschi, and G. B. Zorzoli. Energia nucleare (Milan) 7, 611-29(1960) Sept. (In English)

The possibility of producing a moderating medium with a C : H ratio close to 10 by impregnating graphite with diphenyl was investigated. The impregnated graphite production facility is described, along with a survey of the nuclear properties of the material produced. Thermal diffusion-length measurements on such a moderator are illustrated, and the experimental results are discussed. (auth)

840

ELECTRON PENETRATION IN SOLIDS. I. INTENSITY OF ELECTRON BEAMS. TRANSVERSE ELECTRON TRACKS. A. F. Makhov (Leningrad Inst. of Precision Mechanics and Optics). Fiz. Tverdogo Tela 2, 2161-71 (1960) Sept. (In Russian)

The passage of electrons through thin layers of Al, Si, Cu, Ge, Bi, and Al_2O_3 was studied, and a method is described for developing curves for determining electron attenuation in thick specimens of solids. (R.V.J.)

841

ELECTRON PENETRATION IN SOLIDS. II. ELECTRON DISTRIBUTIONS IN DEPTH. A. F. Makhov (Leningrad Inst. of Precision Mechanics and Optics). Fiz. Tverdogo Tela 2, 2172-5(1960) Sept. (In Russian)

Evaluations were made of electron depth distribution in Al, Si, Cu, Ge, and Al_2O_3. The universal concept of distribution in relation to initial electron energy is presented. It was found that within depth distribution limits it is impossible to separate any narrow layer with localized electron-beam absorption. (tr-auth)

842

ON THE PENETRATION OF ELECTRONS IN SOLIDS. III. ABSORPTION OF ELECTRON BEAM ENERGY. A. F. Makhov (Leningrad Inst. of Precision Mechanics and Optics). Fiz. Tverdogo Tela 2, 2176-84(1960) Sept. (In Russian)

Characteristics determining electron absorption by solids were evaluated. The evaluation method was developed on the basis of regularities described by previously published works dealing with transverse electron range and electron-beam intensity. Electron distribution according to energy, the mean electron energy at an arbitrary depth in solids, and the dependence of absorbed energy on depth are evaluated for Al, Si, Cu, Ge, Bi, and Al_2O_3. (tr-auth)

843

SOME OBSERVATIONS ON THE ENERGY SPECTRUM OF LOW ENERGY BREMSSTRAHLUNG FROM ELECTRONS OF ENERGY $\leq 10^{12}$ eV. P. K. Aditya (Panjab Univ., Chandigarh, India). Indian J. Phys. 34, 302-6(1960) July.

Observations were made on the energy spectrum of photons of energy greater than 30 Mev emitted by bremsstrahlung from high-energy electrons of 10^{11} to 10^{12} ev. This observation is of importance from the point of view of checking the influence of the density of the medium. No significant departure from the conventional theory was observed. (auth)

844

SPACETIME OF THE ELEMENTARY PARTICLES. R. Finkelstein (Univ. of California, Los Angeles). J. Math. Phys. 1, 440-50(1960) Sept.-Oct.

The possibility is examined that physical space is characterized by a torsion, or an asymmetric connection, which is determined by the matter field. There exists a space with uniform torsion with the same metrical properties as conventional microspace; it is isotropic and homogeneous with a very large radius of curvature ($R \cong 10^{28}$ cm). The momentum operators form a group and for practical purposes commute. The torsion defines at every point two kinds of parallel transfer or two screw motions of opposite helicity. There are, consequently, two kinds of spinor field associated with the space; they are distinguished by opposite coupling to the torsion. Viewed from within the Lorentz group the torsion produces an axial vector interaction. To interpret the given mathematical model, it is suggested that there exists a universal axial vector coupling between fermions represented by the spinor fields and bosons associated with the torsion; and that this interaction manifests itself macroscopically as a torsion of space, in the same general way that gravitational interactions correspond to a curvature of space. This general assumption leads to cosmological models characterized by relations connecting the average density of matter and the strength of the assumed interaction. For the observed average density of matter in the known universe ($\sim 10^{-30}$ g/cm^3) the proposed axial vector coupling turns out, for a space of uniform torsion, to be of the order of the strong interactions. (auth)

845

ON THE INTERPRETATION OF NUCLEON-NUCLEON INTERACTIONS AT HIGH ENERGIES ON THE BASIS OF THE TWO-CENTER MODEL. J. Burmeister, K. Lanius, and H. W. Meier (Nuclear Physics Inst., German Academy of Sciences, East Ger.). Monatsber. deut. Akad. Wiss. Berlin 1, No. 3, 160-4(1959). (Translated from Referat. Zhur. Fiz. No. 3, 1960, abstract No. 5302)

Further details of the two-center model of two excited nucleons are considered. It is shown that if the meson spectrum in the decay of an excited center is described by the Heisenberg theory in the rest system of the center,

then the average meson energy (in the same system) has little dependence on the number of cascade particles. Finally, the dependence of the number of shower particles on the number of cascade particles on the coefficient of inelasticity and on the energy is close to the corresponding dependence in the Koba theory.

846

SCATTERING OF HIGH-ENERGY ELECTRONS BY PROTONS. R. R. Wilson, D. Berkelman, J. M. Cassels, and D. N. Olson (Cornell Univ., Ithaca, N. Y.). Nature 188, 94-7(1960) Oct. 8.

An investigation was made of high-energy electron scattering in which q^2, the square of the four-momentum transfer, ranged to 25 f^{-2} at 66 and 112°. The procedure is outlined for (a) 66° scattering of 587, 684, 781, 879, and 1034 Mev electrons; (b) 112° scattering of 320 and 761 Mev electrons; and (c) protons recoiling at 66° from electron scattering at 684, 781, 982, 1034, 1173, and 1205 Mev. The counting rate was measured in the region of the peak for the 66° scattering of 982, 1085, 1173, and 1215 Mev electrons, and for the 112° scattering of 909 Mev electrons. The corresponding cross sections were evaluated using the line shape established in the full sets of measurements. The results of this experiment agree well with Stanford data in the overlapping areas. No change was indicated in the conclusion of Hofstadter et al. that the root mean square radii are ~0.8f. (B.O.G.)

847

TREATMENT OF SPECIAL TRANSLATIONALLY INVARIANT THREE-BODY PROBLEMS BY ADAPTED COORDINATES. P. Möbius (Technische Hochschule, Aachen). Nuclear Phys. 18, 224-44(1960) Aug. (2). (In English)

An attempt was made to compute the wave functions of the considered examples as functions of adapted coordinates which were appropriately chosen combinations of the particle coordinates. The purpose of introducing the adapted coordinates was to satisfy automatically most of the conditions which exist for a many-body wave function. The fully classified and antisymmetrized wave function was written as a linear combination of products of space, spin, and isobaric spin functions. The concept of one-particle functions and Slater determinants was completely eliminated. Several examples with translationally invariant interactions are treated, one containing a repulsive core. (auth)

848

AN IMPROVED APPROXIMATION FOR SCATTERING PROBLEMS. P. Swan (Univ. of Melbourne). Nuclear Phys. 18, 245-70(1960) Aug. (2). (In English)

A method for calculating the scattering phase shift in atomic and nuclear collision problems was developed. In the limit of high collision energies the method reduces to a second Born approximation for the phase shift and for low energies to the shape independent formula. The accuracy attained is an order of magnitude better than the first or second Born approximations, owing to the distortion of the wave function of the scattered particle by the potential well being allowed for in a simple manner. The method can be applied over the whole range of energies and involves one extra integral besides the first Born approximation integral. No multiple integrals are needed as in higher Born approximations. A detailed comparison was made between numerical results at a number of energies, for S^3 and S^1 neutron-proton scattering by four central potentials. Phase shifts were computed on the CSIRAC digital computer by numerical solution of the wave equation, by the Born approximation, and by the new method. It was found that the method gives best results for short-tailed potentials. Many-body scattering phenomena may be treated with the same degree of simplification. Charged particle scattering was also considered and the corresponding shape independent formula derived. The latter was tested on S^1 proton-proton scattering. An improved formula for binding energies, not involving any undetermined variational parameters, was obtained and tested on the deuteron. (auth)

849

INVESTIGATION OF THE INTERACTION BETWEEN THE PRODUCTS OF REACTIONS IN WHICH SEVERAL PARTICLES ARE EMITTED. V. V. Komarov and A. M. Popova (Moscow State Univ.). Nuclear Phys. 18, 296-302(1960) Aug. (2). (In English)

A method is presented for investigation of the effect of the interaction between the products of reactions that involve the emission of several particles on the energy distribution of the latter. The spectra of neutrons emitted at angles of 0 and 180° in the center-of-mass system in the $p + d \rightarrow p + p' + n$ reaction were computed for a total reaction energy of ≈4 Mev. Account was taken of pair interaction between nucleons in the final state. Some possible applications of the method are discussed. (auth)

850

ON THE CHOICE OF D-STATE WAVE FUNCTIONS IN TRITON CALCULATIONS. G. H. Derrick (Inst. for Advanced Study, Princeton, N. J.). Nuclear Phys. 18, 303-9(1960) Aug. (2). (In English)

A set of D-state wave functions with the correct asymptotic properties is suggested for use in variation calculations of the triton energy. The matrix elements of the kinetic and potential energy operators are evaluated for these functions. (auth)

851

POLARIZABILITY OF NUCLEONS. A. M. Baldin (Lebedev Inst. of Physics, Moscow). Nuclear Phys. 18, 310-17 (1960) Aug. (2). (In English)

Estimates of dipole polarizabilities of nucleons and the values they involve are given on the basis of data on photoproduction of π mesons and the Compton effect on nucleons. It is indicated that no upper estimate of neutron polarizability exists at present. The preliminary experimental data now available may be interpreted as indicating that a neutron has an abnormally large polarizability. The effects leading to the inapplicability of the impulse approximation for describing the reaction $\gamma + d \rightarrow p + n + \gamma'$ are estimated. It is pointed out that the measurement of the cross section of the reaction $\gamma + d \rightarrow d + \gamma'$ would yield an answer for the value of neutron dipole polarizability. (auth)

852

ELASTIC γ–p SCATTERING AT 40 TO 70 Mev AND POLARIZABILITY OF THE PROTON. V. I. Goldanskiĭ (Goldansky), O. S. Karpukhin, A. V. Kutsenko, and V. V. Pavlovskaya (Lebedev Inst. of Physics, Moscow). Nuclear Phys. 18, 473-91(1960) Sept. (1). (In English)

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 23550.

853

PION-PION EFFECTS IN τ-DECAY. A. N. Mitra (Muslim Univ., Aligarh, India). Nuclear Phys. 18, 502-15(1960) Sept. (1). (In English)

The effects of pion-pion interactions in resonant form in the s-states of isobaric spins 0 and 2 were studied in some detail with respect to the energy and angular distributions

of the unlike pion in τ decay. The relation of the resonance picture with that of the more conventional effective range theory of pion-pion interaction was clarified. It was found that the pion-pion hypothesis is capable of explaining the observed distribution in a variety of ways, depending on the choice of the resonance parameters. In particular, an $I = 0$ interaction was by no means ruled out by experiment. However, on the basis of the present τ decay data, and in the absence of independent information on the nature of the pion-pion interaction, it is not possible to distinguish between the various alternatives. (auth)

854

ANALYTICAL PROPERTIES OF THE SCATTERING AMPLITUDE FOR INELASTIC PROCESSES INVOLVING STRANGE PARTICLES. I. T. Todorov (Joint Inst. for Nuclear Research, Dubna, USSR). Nuclear Phys. 18, 521-8 (1960) Sept. (1). (In English)

The analytical properties of the amplitudes for the processes $(N + \bar{K} \rightarrow Y + \pi)$ and $(N + \pi \rightarrow Y + K)$ were considered on the basis of the principles of covariance, causality, and spectrality. Kinematic characteristics of these processes were obtained in a frame of reference which is a natural generalization of the Breit system. Dispersion relations were derived for imaginary meson masses. The Vladimirov-Logunov theorem concerning the analyticity of the anti-Hermitian part of the amplitude was extended to the case when all particles involved in the reaction possess different masses. In accordance with the results of previous investigations the region thus obtained contains no physical point. (auth)

855

AN EXPERIMENTAL SEARCH FOR DIPOLE STRUCTURE OF THE ELECTRON. George R. Burleson and H. W. Kendall (Stanford Univ., Calif.). Nuclear Phys. 19, 68-78 (1960) Sept. (3). (In English)

By measuring absolute cross sections for the elastic scattering of electrons from the α particle, a determination of the quantity $\alpha(q) = [\lambda^2(q) + \mu^2(q)]$ was found, where $\lambda(q)$ and $\mu(q)$ are structure form factors of an electric dipole moment and an anomalous magnetic dipole moment of the electron. They are functions of the four-momentum transfer q. The result is $\alpha(Q) = (9.3 \pm 6) \times 10^{-5}\ e\hbar/m_0c$, with an additional uncertainty of $\pm 7 \times 10^{-5}\ e\hbar/m_0c$, for $Q \geq 2.25 \times 10^{13}$ cm. The experiment also determined the charge form factor of the α particle. The data correspond to the scattering from a Gaussian charge distribution having an rms radius of $(1.68 \pm 0.04) \times 10^{-13}$ cm. (auth)

856

BRANCHING RATIOS FOR THE DECAY OF p-SHELL Λ-HYPERNUCLEI. R. D. Lawson (Argonne National Lab., Ill.) and M. Rotenberg. Nuovo cimento (10), 17, 449-61(1960) Aug. 16. (In English)

The possibility of determining the spin dependence of the Λ-nucleon force from a study of hypernuclei in which the Λ particle is bound to a nucleus with an incompletely filled (1p) nuclear shell was investigated. It was pointed out that present uncertainties in the data on binding energies of hypernuclei permit only the determination of the combination $E_s + 3E_t$, where E_s and E_t are the singlet and triplet interaction energies, respectively. It was shown that the decay of hypernuclei by π emission can give information regarding the spin dependence of the force if the branching ratio for decay to the ground state and first excited state of the daughter nucleus is measured. In particular, if the spin of ${}_\Lambda B^{12}$ is 2, decay to the first excited state of C^{12} is favored by a factor 1.2 over decay to the ground level. However, if $J = 1$ for this hypernucleus, decay to the ground state is preferred by a factor of 2.4. The change that the interaction of the π^--meson with the C^{12} nucleus produces in the branching ratio was estimated by use of a complex square well potential. Inclusion of the interaction significantly increased the branching ratio for a hypernuclear spin of 2, but did not change the ratio for $J = 1$. On the other hand, for ${}_\Lambda Li^7$ the branching ratio for decay to the ground and first excited state of Be^7 was independent of the spin of hypernucleus. (auth)

857

A THEORY OF HYPERFRAGMENTS. I. BINDING ENERGIES AND LEVEL STRUCTURE. S. Iwao (Univ. of Rochester, N. Y.). Nuovo cimento (10), 17, 491-515(1960) Aug. 16. (In English)

A model for the structure of hyperfragments was developed which is similar to the shell model for ordinary nuclei. The projection theorem relations for s and p shell hyperfragments were worked out and the case of two-particle interactions was dealt with in detail. The interaction parameters for s and p shell hyperfragments were deduced by a fit with the experimental data and the closeness of fit achieved on the model was satisfactory. An interesting inference is that ${}_\Lambda He^4$ has zero spin and hence the kaon is pseudoscalar. A chart of the hyperfragments including energy levels, stability, and possible spins is presented. As a further application of the projection theorem an expression was derived for the magnetic moments of various hypernuclei. The present model is compared with previous work and some comments on the plausibility of the model are made. (auth)

858

MANDELSTAM REPRESENTATION FOR THE LADDER APPROXIMATION OF THE BETHE-SALPETER FORMALISM. G. Wanders (Universität, Hamburg). Nuovo cimento (10), 17, 535-46(1960) Aug. 16. (In English)

A Mandelstam representation is shown to exist for each term of the ladder approximation of the scattering amplitude, in the covariant Bethe-Salpeter formalism. (auth)

859

DISPERSION RELATIONS FOR SCATTERING WAVE FUNCTIONS IN POTENTIAL THEORY. B. Bosco (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nuovo cimento (10), 17, 558-79(1960) Aug. 16. (In English)

Using the well known analytic properties of partial wave functions, dispersion relations were derived which could be transformed by unitarity into singular integral equations. In absence of bound states, a procedure is given which allows the determination, order by order, of the wave function when the S-matrix is known at every order. A quite intuitive deduction of dispersion relations for the case of finite range potential based on the completeness relation is also reported. This result allowed the derivation of dispersion relations for the transition matrix elements. (auth)

860

ON THE μ-e MASS DIFFERENCE. V. Wataghin (Istituto Nazionale di Fisica Nucleare, Bologna and Università, Bologna). Nuovo cimento (10) 17, 611-13(1960) Aug. 16. (In English)

The assymmetry in the interactions of bosons with muons and electrons may be reconciled to the μ-e mass difference by assuming that in the self-energy effect, $g\mu\nu$ and $ge\nu$ are different and are the unrenormalized coupling constants of the boson with the bare muon and bare electron. Values of 10^{-4} and 10^{-3} were obtained for $g\mu\nu$ and $ge\nu$, respectively. (M.C.G.)

861

ON THE INDEFINITE METRIC IN THE LEE MODEL. E. Kazes and C. Kaufman (Pennsylvania State Univ., University Park). Nuovo cimento (10) 17, 616-18(1960) Aug. 16. (In English)

A consistent set of rules was previously developed for handling the Lee model when the coupling constant is imaginary. It is pointed out that the metric operator needed in such a formalism is not unique and that it may result in giving complex norms to states that may or may not contain the ghost state. This freedom is shown not to affect the interpretation of scattering experiments. (M.C.G.)

862

STOCHASTIC EQUATIONS FOR NONEQUILIBRIUM PROCESSES. P. M. Mathews, I. I. Shapiro, and D. L. Falkoff (Brandeis Univ., Waltham, Mass.). Phys. Rev. 120, 1-16 (1960) Oct. 1.

A system of weakly interacting particles is described by a time-dependent joint probability distribution in the occupation numbers of the individual particle states. The "master" equation for the distribution was obtained by considering the time evolution of the system as a Markoff process with transition probabilities per unit time given by first-order quantum mechanical perturbation theory. This was done for particles obeying classical and quantum statistics. The resulting equations include the usual rate equations for the average occupation numbers as special cases; but they also yield all higher moments and correlations in the occupation numbers. The general solution and its properties were discussed for the case in which a relaxing subsystem interacts via binary collisions with a larger system having a fixed but not necessarily thermal distribution. The explicit solution for the joint distribution in occupation numbers for all time was constructed for the case of identical harmonic oscillators which had an arbitrary initial distribution. These interacted via binary collisions with a reservoir of similar oscillators, the coupling being linear in each oscillator coordinate. This model was also generalized and solved for a case in which the number of interacting particles is not conserved. (auth)

863

APPROXIMATE ANALYTIC APPROACH TO THE CLASSICAL SCATTERING PROBLEM. Guy W. Lehman and Kenneth A. Shapiro (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Phys. Rev. 120, 32-6(1960) Oct. 1.

An approximate analytic approach to the problem of determining differential scattering cross sections for classical central-field repulsive forces is described. It was shown that the impact parameter, b, could be approximated by $b = R\cos(\theta/2)$, where R is approximately the distance of closest approach and θ is the scattering angle in the center-of-mass system. A simple approximation gave the potential energy of interaction between two atoms as $V(R) = 2E\sin(\theta/2)$, where E is the energy in the center-of-mass system. Simple analytic expressions for the differential scattering cross section, σ, were derived from the above two relationships for three special cases of a two-parameter screened Coulomb potential energy, $V(R) = Z_1Z_2e^2A\exp(-pAR)\,[1-\exp(-AR)]^{-1}$, where Z_1e is the charge on the ith atom, A^{-1} is a screening radius, and p is an adjustable parameter that is restricted to ½, 1, and 2 in this paper. A new and improved method for calculating σ exactly is also discussed and was used to compute the exact behavior of σ for p = 1. A table is presented which allows one to compare the exact and approximate σ's for p = 1 over a wide range of energy and scattering angles. The agreement is particularly good for large energy transfer. (auth)

864

COLLECTION OF IONS PRODUCED BY ALPHA PARTICLES IN AIR. Z. Bay and H. H. Seliger (National Bureau of Standards, Washington, D. C.). Phys. Rev. 120, 141-3 (1960) Oct. 1.

In the measurement of the ionization caused by alpha particles in air, recombination effects between slowly moving positive and negative ions (the latter formed by electron attachment to oxygen) have to be considered. The usual procedure in such measurements is to determine the saturation current (by extrapolation of reciprocal current versus reciprocal voltage curves to infinite field strength) according to the Jaffé theory. A paper by Wingate, Gross, and Failla casts doubt on the validity of this extrapolation technique by proposing a field-independent part of the recombination amounting to 3.3% at atmospheric pressure in air. This proposal implied that all previous measurements of W_α for air were in error by this amount and that this error was a possible cause for the reported difference (3–4%) between W values for α and β particles in air. This supposedly field-independent part of the recombination was re-examined. The experimental conditions of Wingate, Gross, and Failla were approximated and their effect was not reproduced. Experiments demonstrate the validity of the usual extrapolation techniques. (auth)

865

POSSIBLE METHOD FOR DETERMINING THE PARITY OF THE CASCADE HYPERON. Saul Barshay (Brandeis Univ., Waltham, Mass.). Phys. Rev. 120, 265-6(1960) Oct. 1.

A study of the reaction $\Xi^+ + p \rightarrow K^+ + K^+$ is suggested as a possible means of determining the parity of the cascade hyperon relative to the nucleon. (auth)

866

INTERACTION BETWEEN A PAIR OF K^+ MESONS. Saul Barshay (Brandeis Univ., Waltham, Mass.). Phys. Rev. 120, 267-9(1960) Oct. 1.

An analysis was performed for the reaction $\Xi^+ + p \rightarrow K^+ + K^+ + \gamma$, with subsequent materialization of the photon into an electron-positron pair. In the circumstance that the annihilation of low-energy Ξ^+ proceeds largely via the reaction $\Xi^+ + p \rightarrow K^+ + K^+$ and that the elastic scattering of the Ξ^+ on hydrogen is largely a diffraction effect, a study of the radiative reaction provides, in principle, a means of determining a function related to the phase shifts for the scattering of a pair of K^+ mesons. Under the second assumption alone, an absence of all meson-meson interactions among pions and K mesons could be inferred from the vanishing of a certain angular correlation term in the radiative process. (auth)

867

HIGH-ENERGY ELECTRON-ELECTRON SCATTERING. Yung Su Tsai (Stanford Univ., Calif.). Phys. Rev. 120, 269-86(1960) Oct. 1.

The radiative corrections to the electron-electron scattering of the order α^3 were calculated for the colliding beam experiment and the experiment in which the target electron is at rest initially. The contributions from high-energy real photons were included. The two-photon exchange diagrams were found to give only negligible contributions to the cross sections after infrared cancellation. The effect due to the possible breakdown of quantum electrodynamics is discussed. A preliminary study on the electron-positron colliding beam experiment involving various interactions

was made. The vacuum polarizations involving heavier particles than an electron pair in the closed loop were investigated. (auth)

868

NUCLEON-NUCLEON SPIN-ORBIT INTERACTION AND THE REPULSIVE CORE. G. Breit (Yale Univ., New Haven). Phys. Rev. 120, 287-92(1960) Oct. 1.

Recent proposals to explain the phenomenological repulsive core and spin-orbit interaction in nucleon-nucleon scattering in terms of a vector meson field are discussed. Estimates of the mass of the vector meson made on the basis of the Bryan potential may need some revision on account of insufficiently studied possibilities of modifying that potential. Estimates of interaction constants on the basis of the Signell-Zinn-Marshak potential and the replacement of a two-body relativistic problem by a one-body problem do not appear applicable. Estimates based on a covariant matrix element but neglecting wave function distortion in the analysis of 300-Mev data are shown to be quite uncertain. Accordingly the evidence for a vector meson mass of $3m_\pi$ or $4m_\pi$ also appears to have little weight. Masses $3m_\pi$ and $4m_\pi$ are shown to lead to central-field potential energy tails which extend into the one-pion-exchange potential region and appear therefore to be improbably large. They also lead to repulsive cores that do not fit in with the usual phenomenological hard cores as naturally as the larger heavy-photon masses. Brief mention is made of possible means of detecting the vector meson and of the effects of its finite mean life. (auth)

869

INFLUENCE OF BOSE-EINSTEIN STATISTICS ON THE ANTIPROTON-PROTON ANNIHILATION PROCESS. Gerson Goldhaber, Sulamith Goldhaber, Wonyong Lee, and Abraham Pais (Univ. of California, Berkeley). Phys. Rev. 120, 300-12(1960) Oct. 1.

Recent observations of angular distributions of π mesons in $\bar{p}$-p annihilation indicated a deviation from the predictions of the usual Fermi statistical model. In order to shed light on these phenomena, a modification of the statistical model was studied. The assumption was retained that the transition rate into a given final state is proportional to the probability of finding N free π mesons in the reaction volume, but this probability was expressed in terms of wave functions symmetrized with respect to particles of like charge. The justification of this assumption is discussed. The model reproduced the experimental results qualitatively, provided the radius of the interaction volume was between one-half and three-fourths of the pion Compton wavelength. The dependence of angular correlation effects on the value of the radius was rather sensitive. Quantitatively, there seemed to remain some discrepancy owing to experimental uncertainties or to some other dynamic effects. In the absence of information on π-π interactions and of a fully satisfactory explanation of the mean pion multiplicity for annihilation, the preliminary nature of the results is emphasized. They are, however, an indication that the symmetrization effects may well play a major role in the analysis of angular distributions. It is pointed out that in this respect the energy dependence of the angular correlations may provide valuable clues for the validity of our model. (auth)

870

Kπ INTERACTION IN THE DOUBLE DISPERSION REPRESENTATION. Benjamin W. Lee (Univ. of Pennsylvania, Philadelphia). Phys. Rev. 120, 325-30(1960) Oct. 1.

The low-energy K-π interaction was studied on the basis of the double dispersion representation. Exact dispersion relations for partial wave amplitudes were derived for K-π scattering and for the process $\pi + \pi \rightarrow K + \bar{K}$. These relations were reduced to manageable form and effective-range formulas were derived under the assumption that the K-π interaction proceeds principally through a contact "potential." For the process $\pi + \pi \rightarrow K + \bar{K}$, the initial-state interaction was taken into account. For the p wave of K-π scattering, the two-pion exchange mechanism was considered. Other types of solutions are briefly discussed. (auth)

871

MODIFICATION OF EFFECTIVE-RANGE THEORY IN THE PRESENCE OF A LONG-RANGE POTENTIAL. Larry Spruch, Thomas F. O'Malley, and Leonard Rosenberg (New York Univ.). Phys. Rev. Letters 5, 375-7(1960) Oct. 15.

The limitations to the applicability of the effective range theory are discussed. The original derivations were concerned primarily with strong, short-ranged potentials. A modified shape-independent approximation, taking into account short-range forces, was derived which is valid for low-energy scattering of ions and electrons by neutral atoms or molecules and neutrons by charged systems. (M.C.G.)

872

SINGLE-VIRTUAL-BOSON-EXCHANGE INTERACTION IN HIGH-ENERGY COLLISIONS. Freda Salzman and George Salzman (Univ. of Colorado, Boulder). Phys. Rev. Letters 5, 377-9(1960) Oct. 15.

The model in which two incident particles collide by exchanging a single virtual boson was investigated. It is shown that if long-range interactions dominate in collisions in which the square of the π meson's four-momentum is very small, then a simple field-theoretical model of such collisions results. The main field-theoretical simplification results from the fact that under these conditions the virtual boson behaves as an incoming, almost real, particle. (M.C.G.)

873

RANGE OF PROTON-ANTIPROTON ANNIHILATION. Maurice Lévy (Physique Théorique et Hautes Energies, Orsay, France). Phys. Rev. Letters 5, 380-1(1960) Oct. 15.

Investigations were made of the p-$\bar{p}$ interaction using a "maximum theorem" that relates the total and elastic cross sections to the maximum number of partial waves which contribute to the scattering process. In consideration of experimental data between 200 Mev and 2 Bev, it was found that the ratio of total to elastic cross sections remains practically constant and equal to approximately 300 mb. Thus the range of the interaction region remains constant and equal to 1.5×10^{-13} cm. Data obtained on the total p-$\bar{p}$ cross section gave a value of 55 ± 2 mb at 10.7 Bev. If it is assumed that the annihilation cross section at very high energy is equal to the difference between the p-$\bar{p}$ and p-p total cross sections, the value of 15 mb is obtained. (M.C.G.)

874

CONSISTENCY OF THE $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$ RATE WITH THE $\Delta T = \frac{1}{2}$ RULE. N. Cabibbo and R. Gatto (Università, Rome and Comitato Nazionale per le Ricerche Nucleari, Frascati, Italy). Phys. Rev. Letters 5, 382-4(1960) Oct. 15.

It is shown that there is no contradiction between the observed low frequency of $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$ events and the $\Delta T = \frac{1}{2}$ rule. The total $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$ amplitude is not much larger than the internal bremsstrahlung contribution accompanying the $K^+ \rightarrow \pi^+ + \pi^0$ decay. This contribution

would be of the order e^3, according to the exact $\Delta T = \frac{1}{2}$ rule, but it may compete favorably with the direct amplitude of order e. According to the choice of the sign, the number of $K^+ \to \pi^+ + \pi^0 + \gamma$ events in the region 55 to 75 Mev was found to be larger by a factor of 1.6 for negative interference or 5 for positive interference than the number predicted on the basis of internal bremsstrahlung alone. (M.C.G.)

875

ESTIMATE OF THE NEUTRAL π-MESON LIFETIME. R. F. Blackie, A. Engler, and J. H. Mulvey (Univ. of Oxford). Phys. Rev. Letters 5, 384-5(1960) Oct. 15.

The lifetime of π^0 was determined by analyzing K^+ decays at rest in emulsions. Events were selected in which the $K_{\pi 2}$ mode, $K^+ \to \pi^+ + \pi^0$, was followed by the decay of the π^0 meson to give an electron pair. Both the velocity and direction of flight of the π^0 were determined by the kinematics of the K^+ decay, and the presence of the electron pair allowed the point of decay of the π^0 to be found. The results of 26 pair events were analyzed. The value obtained for the mean lifetime is $(3.2 \pm 1) \times 10^{-16}$ sec. (M.C.G.)

876

π-π SCATTERING, NUCLEON STRUCTURE, AND π-N SCATTERING. J. Bowcock, W. N. Cottingham, and D. Lurié (European Organization for Nuclear Research, Geneva). Phys. Rev. Letters 5, 386-9(1960) Oct. 15.

In a study of the effect of π-π scattering resonance on π-N scattering, single one-dimensional representations were obtained for the π-N scattering amplitudes. A comparison was made between the predictions of this theory and experiment. Good agreement was obtained. The calculation of the two constants that determine the size of the effect of the π-π resonance on π-N scattering amplitude is discussed to explain the discrepancy of the results obtained by this theory and those obtained by Frautschi. (M.C.G.)

877

$\Delta I = \frac{1}{2}$ RULE. Abdus Salam (Imperial Coll., London) and J. C. Ward. Phys. Rev. Letters 5, 390(1960) Oct. 15.

One way of formulating the $\Delta I = \frac{1}{2}$ rule is to postulate the existence of "spurions," neutral isospinor particles carrying no energy and no momentum which are emitted or absorbed in decays of strange particles. In the decay mode $K^0 \to \pi^+ + \pi^-$, it is easy to see that the vacuum expectation value of K^0 would not be zero. Apparent nonconservation of isotopic spin is another expression for the fact that K^0 has nonzero expectation value. This gives a realization for the spurion. (M.C.G.)

878

INVARIANCE OF WAVE EQUATIONS OF MASSLESS PARTICLES OF SPIN HALF. I. FOUR COMPONENT EQUATION. Vachaspati (Univ. of Lucknow, India). Proc. Natl. Inst. Sci. India, Pt. A, 26, 254-62(1960) May 26. (In English)

Invariance of the massless Dirac equation under continuous coordinate transformations was examined. The widest group under which the equation was invariant was found to be the relativistic conformal group. Explicit expressions for the transformed wave function and equations are given. The extent to which the charge conjugate solution may mix was determined. (auth)

879

INVARIANCE OF WAVE EQUATIONS OF MASSLESS PARTICLES OF SPIN HALF. II. TWO COMPONENT EQUATION. Vachaspati (Univ. of Lucknow, India). Proc. Natl. Inst. Sci. India, Pt. A, 26, 326-34(1960) May 26. (In English)

Invariance of the two component neutrino equation under continuous coordinate transformations was examined. The widest group under which the equation was invariant was found to be the relativistic conformal group. Explicit expressions for the transformed wave function and equation are given. It is shown that, in contrast to the four component case, the wave function and its complex conjugate cannot mix. (auth)

880

MAXWELL EQUATIONS IN THE FORM OF TWO-COMPONENT EQUATIONS. Vachaspati (Univ. of Lucknow, India). Proc. Natl. Inst. Sci. India Pt. A, 26, 359-63(1960) July 26. (In English)

It is shown that Maxwell equations can be written in the same form as the two-component neutrino equation. (auth)

881

RIGHT-ANGLE SCATTER FOR X-RAY BEAMS OF 0.14 mm. TO 2.5 mm. COPPER h.v.l. Aaron P. Sanders, C. W. Chin, K. W. Sharpe, Robert J. Reeves, and George J. Baylin (Duke Univ., Durham, N. C.). Radiology 75, 595-8 (1960) Oct.

Right-angle scatter coefficients were determined as a function of half-value layer (from 0.14 to 2.5 mm copper), area of field, and perpendicular distance from the central beam axis. (auth)

882

ELECTROMAGNETIC RADIATION BY A CHARGED PARTICLES BUNCH PASSING BY A WAVEGUIDE WITH AN INFINITE PLANE. Yu. N. Dnestrovskiĭ and D. P. Kostomarov (Moscow State Univ.). Radiotekh i Elektron. 5, 1431-41(1960) Sept. (In Russian)

The radiation emission from a modulated electron beam in a waveguide in an infinite circular medium was studied. The problem is reduced to a system of algebraic equations that are computed for the electron range $\beta = 0.07$ to 0.99. (tr-auth)

883

THE POLARIZATION OF γ-QUANTA IN BREMSSTRAHLUNG OF ELECTRONS ON PROTONS. A. A. Kresnin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur. 5, 137-40(1960) Mar.-Apr. (In Ukrainian)

The polarization of bremsstrahlung of electrons on protons is considered, taking into account the recoil of a proton. Formulas that give the polarization of γ-quanta are obtained in the form of an expansion by powers of q/M to the first order, inclusively. (auth)

884

ASYMMETRY OF $\pi^+ - \mu^+ - e^+$-DECAY IN A MAGNETIC FIELD. A. O. Vaĭsenberg and V. A. Smirnitskiĭ. Zhur. Eksptl'. i Teoret. Fiz. 39, 242-8(1960) Aug. (In Russian)

The dependence of the coefficient of spatial asymmetry in the $\pi^+ - \mu - e$-decay on the magnetic field strength was measured from 0 to 17 kgauss. It is shown that this effect can be explained by the Paschen–Back effect for muonium under the assumption of additional depolarization due to charge exchange at the end of the μ^+-meson range or to exchange collisions after its stoppage. For the NIKFI-R emulsion the minimal value of the asymmetry coefficient is -0.09 ± 0.01 (without the field). The maximal value is -0.29 ± 0.01 (strong fields). The 10% difference between the value of the coefficient -0.29 ± 0.01 and the value -0.33 predicted by the V–A-theory greatly exceeds the experimental errors. No decays involving three electrons were detected among the 340,000 $\pi^+ - \mu - e$-decays examined. (auth)

885

SPACE AND CHARGE PARITY OF A PROTON–ANTIPROTON SYSTEM AND ITS TWO-MESON ANNIHILATION. M. I. Shirokov and E. O. Okonov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 285-92(1960) Aug. (In Russian)

If a proton and antiproton are described by the Dirac equation, the $(p,\bar{p})$ system will possess a definite charge and space parity. To check this consequence of the Dirac equation it is suggested that $\bar{p} + p \rightarrow \pi^+ + \pi^-$ and $\bar{p} + p \rightarrow \pi^0 + \pi^0$ annihilation experiments be performed. (auth)

886

THE SCATTERING MATRIX WITH ACCOUNT OF PAULI INTERACTION. L. G. Moroz and F. I. Fedorov (Inst. of Physics, Academy of Sciences, Belorussian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 293-303(1960) Aug. (In Russian)

A 10-dimensional formulation of electromagnetic-field theory involving first order equations is employed. Within the framework of this formalism an expression is derived for the quantum electrodynamic scattering matrix with account of the so-called Pauli interaction. Scalar-photons are not required in the theory. The states of a free -field longitudinal photon are used with the purpose of simplifying the calculations of the transition probabilities for unpolarized light. (auth)

887

ON PERTURBATION THEORY FOR LARGE QUANTUM SYSTEMS. Yu. L. Mentkovskii (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 317-21(1960) Aug. (In Russian)

A new form of the Van Hove–Hugenholtz perturbation theory expansion is proposed. The series obtained differ from the more familiar ones by the simplicity of the energy denominators, a fact which may be useful, for example, in calculating the excited states. The deduction of the indicated expansions is quite simple. (auth)

888

EFFECT OF WEAK INTERACTIONS ON THE ELECTRON PROPERTIES OF FERMIONS. A. M. Brodskii. Zhur. Eksptl'. i Teoret. Fiz. 39, 322-5(1960) Aug. (In Russian)

Proper mass effects and peculiarities of behavior of fermions in a magnetic field caused by the universal Fermi interaction are considered in the first order in the constant G_F. It is shown that violation of parity in weak interactions does not induce any violation of parity in the field mass. An expression describing the effect of weak interactions on the electromagnetic properties of the fermions is found. The expression is proportional to the external current and is $\sim 10^{-2}$ times smaller than the similar expression which is obtained by taking into account the vacuum terms in electrodynamics. (auth)

889

RADIATION FROM A PARTICLE MOVING ACROSS THE INTERFACE OF TWO MEDIA WITH ACCOUNT OF THE EFFECT OF MULTIPLE SCATTERING. G. M. Garibyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 332-6(1960) Aug. (In Russian)

The spectral distribution of the intensity of the electromagnetic radiation emitted by a charged particle in passing across the interface between two media is derived by taking into account the influence of multiple scattering. (auth)

890

SECOND ORDER EQUATIONS FOR SPINOR FIELDS. V. S. Vanyashin (Dnepropetrovsk State Univ., [USSR]). Zhur. Eksptl'. i Teoret. Fiz. 39, 337-9(1960) Aug. (In Russian)

Second-order wave equations for the fermions are investigated on the basis of Lagrangian formalism. It is shown that an additional degree of freedom of the particles is due to two orientations of imaginary electric dipole moments which may possess a vacuum real part. (auth)

891

ON THE POSITION OF THE NEAREST $\pi\pi$-SCATTERING AMPLITUDE SINGULARITIES. V. A. Kolkunov, L. B. Okun, A. P. Rudik, and V. V. Sudakov. Zhur. Eksptl'. i Teoret. Fiz. 39, 340-4(1960) Aug. (In Russian)

A number of $\pi\pi$-scattering diagrams are considered for which the so-called singular curves (threshold of appearance of the imaginary part of the amplitude) possess asymptotic values equal to 16 μ^2. (auth)

892

SPECTRA OF K_{e4} AND $K_{\mu 4}$ DECAYS. E. P. Shabalin. Zhur. Eksptl'. i Teoret. Fiz. 39, 345-54(1960) Aug. (In Russian)

The electron and π meson energy spectra and the $\pi-e$ angular correlation in K meson decays $K \rightarrow 2\pi + e + \nu$, and the μ meson spectrum and the spectrum of the effective mass of two π mesons in the $K \rightarrow 2\pi + \mu + \nu$ decay were obtained. The K_{e4} decay probability is found to comprise $0.8 \cdot 10^{-3}$ of the K_{e3} decay probability. The $K_{\mu 4}$ decay probability is smaller than that for K_{e4} decay by an order of magnitude. (auth)

893

INELASTIC INTERACTIONS IN THE FINAL STATE AND NEAR-THRESHOLD PECULIARITIES. L. I. Lapidus and Kuang-chao Chou. Zhur. Eksptl'. i Teoret. Fiz. 39, 364-72 (1960) Aug. (In Russian)

It is shown that near the threshold of the reaction $C + D \rightarrow E + F$ nonmonotonous energetical variation may arise in the energy spectrum of particles a produced in reactions of the type $A + B \rightarrow a + C + D$. As an example the spectrum of K mesons produced in the $N + N \rightarrow \Lambda + N + K$ reaction is analyzed for $\Lambda - N$ pair energies lying near the threshold of the process $\Lambda + N \rightarrow \Sigma + N$. The energy spectrum of K mesons produced by unpolarized nucleons and the polarization of baryons produced by polarized nucleons in the process $p + p \rightarrow \Lambda + N + K$ are derived. Cases of nonmonotonous energetical variation in the particle spectra are discussed for a number of other reactions. Creation of $Y - K$ pairs in (np) collisions is discussed in the appendix and the case of a scalar K particle is considered. (auth)

894

VARIATION OF THE ADIABATIC INVARIANT OF A PARTICLE IN A MAGNETIC FIELD. A. M. Dykhne and V. L. Pokrovskii (Inst. of Radiophysics and Electronics, Siberian Section, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 373-7(1960) Aug. (In Russian)

The variation of the adiabatic invariant of a particle moving in an axially symmetric inhomogeneous magnetic field is determined. The problem is solved for the model Hamiltonian usually employed. (auth)

895

THE $\Sigma^0 \rightarrow \Lambda^0 + 2\gamma$-DECAY AND MAGNETIC MOMENT OF THE Σ^0-HYPERON. L. B. Okun and A. P. Rudik. Zhur. Eksptl'. i Teoret. Fiz. 39, 378-83(1960) Aug. (In Russian)

The possibility of determining the magnetic moment of the Σ^0 hyperon by comparing the $\Sigma^0 \rightarrow \Lambda^0 + 2\gamma$ and $\Sigma^0 \rightarrow \Lambda^0 + \gamma$-decays is examined. (auth)

896

PHOTOPRODUCTION OF π-MESONS ON NUCLEONS IN PERIPHERAL COLLISIONS. V. B. Berestetskii and E. D. Zhizhin. Zhur. Eksptl'. i Teoret. Fiz. 39, 418-26(1960) Aug. (In Russian)

Production of π mesons in peripheral collisions between γ quanta and nucleons is considered. The photoproduction amplitudes are calculated in the one-meson and two-meson approximations. For this purpose the dispersion relations and the unitarity condition for the photoproduction amplitude and its analytical properties are employed. By employing the corresponding experimental data and the relations deduced the $(\gamma\pi\pi\pi)$ vertex function can be determined near the point $t = 4\mu^2$ and the π-meson-nucleon coupling constant. (auth)

897

BREMSSTRAHLUNG FROM A DISTRIBUTED PROTON. N. A. Guliev and E. M. Epshteĭn (Inst. of Physics, Academy of Sciences, Azerbaĭdzhan SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 432-3(1960) Aug. (In Russian)

An expression is obtained for the form factor of a proton emitting bremsstrahlung radiation as a result of diffraction scattering in the nuclear field. (auth)

898

PION-NUCLEON SCATTERING AT LOW ENERGIES. A. V. Efremov, V. A. Meshcheryakov, and D. V. Shirkov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 438-49(1960) Aug. (In Russian)

Integral equations for π-N scattering partial waves in the low-energy region are derived on the basis of the Mandelstam representation. The kernels of the equations contain lowest π-π scattering phases. (auth)

899

ON A CERTAIN METHOD FOR SOLUTION OF FIELD THEORY PROBLEMS INVOLVING A STATIONARY NUCLEON. B. M. Barbashov and G. V. Efimov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 450-60(1960) Aug. (In Russian)

A method is proposed for solving field theory problems involving a stationary nucleon. The formalism is not connected with the magnitude of the coupling constant and is based on the matrix methods for solution of linear differential equations developed by Lappo-Danilevsky. The solution is obtained in the form of a series for which the concrete form of the n^{th} term is known. The S matrix is derived for the scalar charge theory with a stationary source. The renormalization constants are calculated by the method proposed. In this model logarithmic singularities do not appear in the renormalized charge g_r upon transition to point interaction. (auth)

900

ENERGY AND ANGULAR DISTRIBUTIONS IN HYPERNUCLEAR DECAYS. V. A. Lyul'ka. Zhur. Eksptl'. i Teoret. Fiz. 39, 471-5(1960) Aug. (In Russian)

The energy and angular distributions for the $_{\Lambda}He^4 \rightarrow He^3 + p + \pi^-$ decay are computed in the impulse approximation. It is demonstrated that if interaction in the proton–He^3 system is considered, satisfactory agreement with the experimental data is obtained. The energy distribution of π^- mesons from the decay $_{\Lambda}H^3 \rightarrow d + p + \pi^-$ is considered but in less detail. (auth)

901

PION-PION INTERACTION AND THE ELECTROMAGNETIC STRUCTURE OF THE NUCLEON IN THE STATIC THEORY. E. V. Teodorovich (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 39, 476-9(1960) Aug. (In Russian)

An estimation of the quadratic mean radius of the π-meson charge distribution is made on the basis of the relation between this radius and the π-π scattering resonance energy derived from the dispersion relations. The calculations of the quadratic radius of the nucleon charge distribution are performed within the framework of the Chew–Low–Wick static theory by considering the electromagnetic structure of the meson. Good agreement with the experimental data was obtained. (auth)

902

EFFECT OF MULTIPLE SCATTERING ON THE PROPER FIELD OF A FAST CHARGED PARTICLE. F. F. Ternovskiĭ (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 39, 491-6(1960) Aug. (In Russian)

It is shown that due to the effect of multiple scattering, the proper field of a fast charged particle passing through a medium decreases at a higher rate with increase of the distance from the axis of motion than in vacuum. This effect leads to the emission of radiation when the particle passes from one medium to another and affects direct pair production. (auth)

903

THE CROSS SECTION OF π MESON RECHARGE BY π-MESON IN THE REACTION ANALYSIS $\pi^- + p \rightarrow \pi^- + \pi^+ + N$ AT THE ENERGY OF 290 Mev. Yu. A. Batusov, S. A. Bunyatov, V. M. Sidorov, and V. A. Yarba (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 506-9(1960) Aug. (In Russian)

Data on π-π interaction cross sections are tabulated and reactions $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ in the photoemulsion (200 events) are studied. The emulsions were irradiated by a π^- meson beam from a cyclotron; the mean energy of the primary π mesons, considering bremsstrahlung in the emulsion, was 290 ± 15 Mev. The data on π-π scattering S-wave lengths (in $\hbar/\mu_\pi$ c units) are tabulated and correlated with published data. Owing to discrepancies between the obtained data and various published data, new experiments are planned at 240 to 250 Mev. (R.V.J.)

Nuclear Properties and Reactions

904 AFOSR-TN-60-1041

Hebrew Univ., Jerusalem.

NUCLEAR RESONANCE ABSORPTION IN Dy^{161} SITUATED IN Dy_2O_3 AND DYSPROSIUM IRON GARNET. Technical Note No. 1. S. Ofer, P. Avivi, R. Bauminger, A. Marinov, and S. G. Cohen. July 1960. 13p. Contract AF61(052)-347.

The recoil-free resonant absorption of the 26-kev γ ray emitted in the decay of Tb^{161} by absorbers containing Dy^{161} was investigated. High Mossbauer efficiencies at room temperatures were observed for sources and absorbers in the form of oxide and rare earth iron garnet. The line shapes obtained were very broad, even up to 100 times the natural width, and showed no resolved sharp lines. The broad lines are interpreted as owing to a wide complicated hyperfine spectrum whose details were smoothed out by transitions between magnetic sub-levels induced by paramagnetic relaxation. The effective magnetic field at the nucleus in the rare earth garnet was about 2×10^6 oe. (auth)

905 AWRE-0-27/60

United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England.

NEUTRON CROSS-SECTIONS OF BERYLLIUM IN THE ENERGY RANGE OF 0.025 eV–15 MeV. K. Parker. Sept. 1960. 38p.

Possible reactions of neutrons with beryllium are discussed for energies up to 15 Mev. Tables of data were compiled for elastic, inelastic, and total cross sections, and for angular and energy distributions of beryllium at 0.025 ev to 15 Mev. 86 references. (C.J.G.)

906 CU(PNPL)-201
Columbia Univ., New York.
NUCLEAR ELECTRIC MONOPOLE TRANSITIONS IN O^{16}, Ca^{40}, Ge^{72} AND Zr^{90} (thesis). Michael Nessin. May 18, 1960. 98p. Contract AT-30-1-GEN-72. OTS.

A study was made of electric monopole transitions from the 0^+ first excited states of certain nuclei. A search for 6.05 Mev O^{16} EO conversion electrons gave an upper limit of 1×10^{-4} for the ratio of the probability for conversion electrons to that of pair emission. Ca^{40} EO conversion electrons were observed and a ratio of W conversion/W pair = $(6.94 \pm 0.20) \times 10^{-3}$ was obtained, which agreed very well with theoretical prediction. The momentum distributions of both components of pairs from the first excited state were observed and agreed with the theoretical predictions. An upper limit of 6×10^{-3} was placed on the ratio of double gamma emission to pair emission. The energy of the first excited state was found to be 3.353 ± 0.003 Mev by measurement of the conversion electron energy. An excitation function for population of the first excited state of Ge^{72} by inelastic scattering of protons was observed between 2.3 and 6.2 Mev proton bombarding energy. The K and L + M EO conversion electrons were resolved and the ratio $W_K/W_{L+M} = 8.70 \pm 0.06$ was obtained. The energy of the first excited state was found to be 0.690 ± 0.001 Mev. An excitation function for population of the first excited state of Zr^{90} by inelastic scattering of protons was obtained between 3.35 and 6.5 Mev proton bombarding energy. The momentum distributions of both components of pairs were observed and agreed with the theoretical predictions. The energy of the first excited state was measured as 1.762 ± 0.002 Mev. 2.38 ± 0.08 was obtained for the ratio W conversion/W pair. The K and L + M conversion electrons were resolved and the ratio $W_K/W_{L+M} = 7.06 \pm 0.08$ was obtained. (auth)

907 GAMD-1251
General Atomic Div., General Dynamics Corp., San Diego, Calif.
I.B.M. 650 PROGRAM FOR THE CALCULATION OF CAPTURE-SCATTERING AND TOTAL CROSS-SECTIONS FOR S-, P- AND D-WAVE NEUTRONS. Carl Crafton and Bernard Roos. Feb. 6, 1960. 20p. Project 40. Contract AT(04-3)-187. (MGCR-RP-175; MA-S89-1).

An IBM-650 program was written to obtain values for both p- and d-wave strength functions and for calculating unmeasured capture cross-sections. A flow chart and operating instructions are given. (W.D.M.)

908 NDA-2133-1
Nuclear Development Corp. of America, White Plains, N. Y.
FAST NEUTRON CROSS SECTIONS OF MANGANESE, CALCIUM, SULFUR, AND SODIUM. Quarterly Progress Report No. 1 Covering the Period December 1, 1959–February 29, 1960. E. S. Troubetzkoy. Mar. 31, 1960. 18p. Contract DA 18-108-405-CML-295. (AD-236431).

Progress is reported on the compilation of neutron-cross-section data for manganese, calcium, sulfur, and sodium. Preliminary values are reported for some of the sulfur and sodium cross sections. (auth)

909 NDA-2134-2
Nuclear Development Corp. of America, White Plains, N. Y.
FAST NEUTRON CROSS SECTIONS OF THORIUM-232, PROTACTINIUM-233, URANIUM-233, BERYLLIUM, SODIUM, AND IRON. M. H. Kalos and E. S. Troubetzkoy. Sept. 1, 1960. 30p. Contract AT(30-1)-2303. OTS.

The work was performed as part of the U^{233}–Th^{232} fast breeder reactor feasibility study. All cross sections required for neutron diffusion calculations were considered. These included total, fission, capture, (n,2n), elastic, and inelastic scatter. (W.D.M.)

910 NP-9140
Wright Air Development Center. Aeronautical Research Lab., Wright-Patterson AFB, Ohio.
DETECTION OF 900 Kev VECTOR POLARIZED DEUTERONS WITH THE REACTION $Li^6(d,\alpha)He^4$. Lee G. Pondrom and J. W. Daughtry. [1960]. 23p.

Paper delivered at the 1960 Basel Conference on Polarization Phenomena of Nucleons.

The existence of vector-polarized deuterons after elastic scattering through 45° in the center-of-mass system from He^4 at the 1.070-Mev resonance energy was demonstrated by observing a right-left asymmetry in the α particles from the reaction $Li^6(d,\alpha)He^4$. The polarization has the correct energy dependence through the resonance. In viewing the second reaction at 45° in the lab system, if we let $R = I_0(1 - \epsilon)$ and $L = I_0(1 + \epsilon)$, then for a left-scattered polarized beam $\epsilon = -0.065 \pm 0.010$. Similar measurements on $H^2(d,p)H^3$ at 45° give $\epsilon = -0.03 \pm 0.025$. (auth)

911 TID-6609
Bartol Research Foundation, Swarthmore, Penna.
STUDIES RELATING TO SCATTERING OF NEUTRONS AND ALLIED PHENOMENA. Proposal for Renewal of Contract AT(30-1)-1679 [for] Period: January 1, 1961–December 31, 1961 and Annual Progress Report for 1960. Douglas M. Van Patter. Sept. 14, 1960. 40p. OTS.

Some $(n,n'\gamma)$ γ-ray-production cross sections and inelastic-neutron-scattering cross sections are given for even-2 and odd-N nuclei. Data were taken at 2.2 Mev using a ring geometry to obtain the angular distribution of the 1.84-Mev γ arising from the Sr^{88} $(n,n'\gamma)$ reaction. Smooth fluctuations from the general monotonic increase in total neutron cross sections with atomic weight at a fixed neutron energy were observed and were consistent with optical model predictions. The elastic-scattering cross sections of calcium and strontium were measured. (W.D.M.)

912 UCRL-6003
California. Univ., Livermore. Lawrence Radiation Lab.
CAPTURE-GAMMA DETERMINATION OF VANADIUM LEVELS. J. E. Schwiger. Jan. 1960. 96p. Contract W-7405-eng-48. OTS.

A fast-coincidence scintillation spectrometer was developed for thermal-neutron capture-gamma studies at the Livermore 1-Mw pool type reactor. The added-neutron binding energy in V^{51} and V^{52} was measured as 11.1 ± 0.1 and 7.30 ± 0.05 Mev, respectively. Cascade radiations for V^{51*} and V^{52*} were observed, and decay schemes are established which verify previously proposed (p,p') and (d,p) determined level schemes. Spin assignments for most of the V^{51*} (p,p') reported levels below 4.0 Mev are proposed and the level order for the $(1f_{7/2})^3$ proton-configuration levels is established as $7/2^-$ (ground state), $5/2^-$, $3/2^-$, $11/2^-$, $9/2^-$, and $15/2^-$ spin with excitation energies of 0.32, 0.93, 1.61, 1.81, and 2.70 Mev, respectively. Of the various nuclear force assumptions that can be made, the short-range force approximation (δ-type interaction) and weak surface-coupling effects for V^{51*} configuration states appear to give the best match between theory and experiment. A previous calculation using experimentally measured splittings of the j^2 configuration together with tabulated coefficients of fractional parentage gives excellent agreement with experimental results. Evidence is also found for $(1f_{7/2})^2_0\, 2p_{3/2}$– and $(1f_{7/2})^2_2\, 1f_{5/2}$-proton single-

particle levels at 2.41 and 2.55 Mev respectively as well as for additional low-spin states between 2.70 and 3.38 Mev which possibly represent even states resulting from excitation of a lower shell proton to give a $(1f_{\frac{5}{2}})^4_0$ configuration plus a proton hole in the vacated shell. Experimental results suggest that the V^{51*} 20-28 core is a more rigid structure than the Ca^{43*} 20-20 core. Several V^{52*} low-energy crossover (without stopover) transitions were observed: two for transitions from the 0.78-Mev level to the ground and 0.13-Mev level (the latter being the more intense) but not to the 0.42-Mev level and one for transitions from the 0.83-Mev level to the ground state only. The 0.42-Mev level makes both crossover and stopover transitions to the ground and 0.13-Mev levels (the former being the stronger). Some evidence exists to suggest that the low-lying V^{52*} states arise from excitations of the $(1f_{\frac{5}{2}})^3$ proton configuration alone. (auth)

913 UCRL-6022-T

California. Univ., Livermore. Lawrence Radiation Lab. A NOTE ON THE OPTICAL POTENTIAL WITH THE PAULI PRINCIPLE. Marvin H. Mittleman. July 1960. 11p. Contract W-7405-eng-48. OTS.

The idea of determining potentials from phase shifts is called the "optical model," whereas the construction of an effective single particle scattering potential from the known two-body forces is called the "optical potential." A novel method is given for construction of the optical potential with the Pauli principle, and its difficulties are pointed out. One connection between the optical potential and optical model is given. (auth)

914 UCRL-9296

California. Univ., Berkeley. Lawrence Radiation Lab. SOME LOW-TEMPERATURE NUCLEAR-ORIENTATION STUDIES (thesis). James Frederick Schooley. July 19, 1960. 45p. Contract W-7405-eng-48. OTS.

Nuclear-orientation experiments were performed on Pm^{144} included as the tripositive ion in the crystal Nd $(C_2H_5SO_4)_3$-$9H_2O$. Theoretical predictions of Elliott and Stevens regarding the fine-structure splitting of the Pm^{+3} electronic state $^5I_4$ were confirmed. The magnetic hyperfine-structure parameter was measured to be 0.0063 $cm^{-1} \pm 0.0002$ cm^{-1} or 0.0055 $cm^{-1} \pm 0.0002$ cm^{-1} for the nuclear spin of Pm^{144} equal to 5 or 6, respectively. On the basis of theoretical prediction of the hyperfine-structure parameter, the nuclear magnetic moment can be calculated as 1.68 ± 14 nm or 1.75 ± 0.14 nm for the respective nuclear-spin choices. The John-Teller splitting parameter was measured as 0.014 cm^{-1}. Nuclear alignment experiments were performed on Np^{235} included as the NpO_2^{++} ion in the crystal $UO_2Rb(NO_3)_3$. The temperature of the crystal was reduced to ~0.14°K by contact with magnetically cooled $MnSO_4 \cdot (NH_4)_2SO_4 \cdot 24H_2O$. Anisotropy was detected in the 106-kev gamma ray which depopulates the 392-kev level in Pu^{239}. This anisotropy indicates that the 10^{-7}-sec lifetime of the 392-kev level does not result in appreciable attenuation of the anisotropy or that the daughter state itself is aligned through its own hyperfine-structure interactions. (auth)

915 USNRDL-TR-458

Naval Radiological Defense Lab., San Francisco. GAMMA-RAY SPECTRA OF Te^{133m} AND Te^{134}. J. M. Ferguson, D. L. Love, and D. Sam. Aug. 8, 1960. 19p.

Tellurium radionuclides were separated from U^{235} fission products, and their gamma-ray energies and abundances were measured by scintillation techniques. Te^{134} has four gamma rays ranging in energy from 79 to 262 kev. An equilibrium mixture of Te^{133m} and Te^{133} has 11 gamma rays ranging in energy from 309 to 973 kev. A partial decay scheme for Te^{133m} is proposed. The half-lives of Te^{133m} and Te^{134} were remeasured as 50 and 42 min, respectively. (auth)

916

MIXING RATIOS OF $2^+ \rightarrow 2^+$ TRANSITIONS IN EVEN-EVEN NUCLEI IN THE MASS REGION A = 122-128. I Asplund, L. G. Strömberg, and T. Wiedling (Univ. of Stockholm). Arkiv Fysik 18, 65-74(1960). (In English)

Angular correlation measurements were carried out on some even-even nuclei in the mass region A = 122 to 128 in an attempt to study the variation of the mixing ratio E2/M1 in 2+ to 2+ transitions when a neutron or proton pair is added to the nucleus. The 2+ to 2+ transitions discussed were found to be of almost pure E2 character. The following nuclei were studied: Te^{122}, Te^{126}, Xe^{126}, and Xe^{128}. (auth)

917

PHOTOPROTONS FROM NITROGEN. I. Wahlström and B. Forkman. Arkiv Fysik 18, 83-95(1960). (In English)

The results of a study of the (γ,p) reaction in N^{14} are presented. A target of nitrogen gas at 1 atm pressure was used. The source of photons was the bremsstrahlung beam of a 30-Mev synchrotron. Irradiations were carried out at 11.5 and 15.5-Mev maximum bremsstrahlung energy. The protons were recorded by means of nuclear emulsions. Both irradiations gave proton spectra containing well-resolved peaks. By comparing the two proton spectra the peaks could be identified as resonances in N^{14}. The result was compared with the inverse process and measurements of (γ,n) and (γ,p); the agreement was found to be quite satisfactory. The cross section of the (γ,p) reaction up to 15 Mev is given. (auth)

918

DETERMINATION OF THE β-DECAY CONSTANT OF RUBIDIUM-87 WITH THE AID OF A GEOCHEMICAL METHOD. G. V. Ovchinnikova (Lab. of the Geology of the Precambrian, Academy of Sciences, Moscow). Geokhimiya No. 5, 392-8(1960). (In Russian)

A determination of Rb^{87} and Sr^{87} content was carried out on two mica samples of a known age in order to calculate the decay constant of Rb^{87}. The method of isotopic dilution was used for the determination. The obtained value of the decay constant, equaling $(1.38 \pm 0.05)10^{-11}$ $years^{-1}$, agrees well with the value previously obtained by other investigators. Curves of the dependence of relative errors in the determination of Rb^{87} and Sr^{87} on the isotopic composition of the mixture under investigation are given. (auth)

919

CONCERNING TWO QUANTA TRANSITIONS IN Ba^{137}. W. Beusch (Physikalisches Institut der ETH, Zurich). Helv. Phys. Acta 33, 363-94(1960). (In German)

According to second-order perturbation theory, transitions in nuclear isomers should occur for which two quanta are emitted with arbitrarily divided energies. The transition probability for such a process was calculated for Ba^{137m} for various multipole transition combinations. The dependence of transition probability upon energy for electric multipole transitions differed from that for magnetic. Experimental coincidence measurements were undertaken using high time resolution and two-dimensional pulse analysis. Corrections were determined for random coincidences and for contamination activity. The probability for emission of two Bremsstrahlung quanta was calculated; it was found to be negligibly small. The measured ratio of transition probabilities for first and for second order

processes was $T^{(2)}: T^{(1)} = (6.4 \pm 3.1) \times 10^{-6}$. This value was approximately 10 times smaller than that expected from a theoretical estimate. (auth)

920

γ−γ CORRELATION MEASUREMENTS OF Sm^{152}, Gd^{152} AND Gd^{154}: SPIN SEQUENCE, MIXING RATIO, AND g-FACTOR. P. Debrunner and W. Kündig (Physikalisches Institut der ETH, Zurich). Helv. Phys. Acta 33, 395-428 (1960). (In German)

Angular-correlation methods were used to establish the spin sequence and the multipole mixing ratio of several γ-ray cascades in the decay of Eu^{152}, Eu^{152m}, Eu^{154}, and to measure the nuclear g-factor of Sm^{152}. For liquid sources, only the 123 kev level of Gd^{154} showed attenuation. It was found that each level in the decay of Eu^{152} to Sm^{152} corresponds to a level of the same spin and parity in the decay of Eu^{154} to Gd^{154}. In Gd^{154} an additional 2^- level of 1721 kev exists, which decays by E1 radiation to the 2^+, K = 2 and the 2^+, K = 0 levels. The measurements of the 1290 to 344 and 1100 to 344 kev cascades in Gd^{152} were consistent with a tentative spin assignment of 2 or 3 to the (1634 ± 25) kev level and of 4 to the 1444 kev level. The g-factor of the first rotational state of Sm^{152} was measured using liquid and polycrystalline sources. Assuming the internal field of the paramagnetic electron shell to be proportional to T^{-1}, the experimentally observed values $g_{eff} = 0.38 \pm 0.06$ at 300°K and $g_{eff} = 0.180 \pm 0.065$ at 1200°K yield a g-factor $g_N = 0.115 \pm 0.075$. (auth)

921

SPIN-ORBIT SPLITTING AND TENSOR FORCE. Akito Arima (Argonne National Lab., Ill.). Nuclear Phys. 18, 196-223(1960) Aug. (2). (In English)

The second-order effect of the tensor force was calculated in nuclei that had several nucleons outside closed shells. This second-order effect caused a modification of the first-order secular equation of the degenerate shell-model states $(nl)^p$, where nl is an orbit of the L-S coupling shell model and p is the number of nucleons outside closed shells. This modification is equivalent to the introduction of a slight change in the one-particle energy, one-body spin-orbit interaction $\Sigma\xi s_i \cdot l_i$, effective nonlocal two- and three-body forces, and an energy depression that is common to all states. Here $\xi = C_0 + (p-1)C_1$, where C_0 and C_1 are constant as long as the average potential of the shell model does not change. C_0 and C_1 were calculated in the (1p)-shell, and $C_0 \approx 4C_1$. The constant C_0 is about −1.0 to −1.5 Mev. In this numerical calculation, the harmonic-oscillator wave functions were adopted as individual wave functions, and either the tensor force suggested by meson theory or the phenomenological strong tensor force was assumed. It is very interesting to note that $\xi(N^{15})/\xi(He^5) \approx 3.5$. If the three-body effect is neglected, the modified secular equation results in the intermediate-coupling shell-model Hamiltonian, provided that the two-body effective potential is replaced by the usual potential which has the same matrix elements as the effective one. (auth)

922

INDIVIDUAL LEVELS AT THE FISSION THRESHOLD. M. Demeur, P. Janssens, and J. Lardinois (Université Libre, Brussels). Nuclear Phys. 18, 280-5(1960) Aug. (2). (In French)

A dumbbell potential was quantized in order to find properties of individual levels in a nucleus near the fission threshold. (auth)

923

STUDY OF EXCITED LEVELS OF B^{11} BY THE $B^{10}(d,p)B^{11}$ REACTION. S. Gorodetzky, M. Croissiaux, A. Gallmann, P. Fintz, J. Samuel, and G. Bassompierre (Institut de Recherches Nucléaires, Strasbourg). Nuclear Phys. 18, 286-95(1960) Aug. (2). (In French)

Angular distributions of protons p−γ and γ−γ angular correlations for different levels were obtained in the reaction $B^{10}(d,p)B^{11}$ at $E_d = 1.25$ and 4.6 Mev. The interpretation of the results is consistent with the value $3/2^-$ or $5/2^-$ for the total angular momentum and parity of the 4.46-Mev level in B^{11}. (auth)

924

A BREMSSTRAHLUNG EXPERIMENT TO MEASURE THE TIME DELAY IN NUCLEAR REACTIONS. R. M. Eisberg (Univ. of Minnesota, Minneapolis), D. R. Yennie, and D. H. Wilkinson. Nuclear Phys. 18, 338-45(1960) Aug. (2). (In English)

It should be possible to measure the time delay in a nuclear reaction, in which both the incident and product particles are charged, by measuring the spectrum of the bremsstrahlung that is produced. The time delay enters the spectrum through a phase factor between the bremsstrahlung amplitude associated with the cessation of the current (due to the incident particle) and the bremsstrahlung amplitude associated with the initiation of the current (due to the product particle). The classical theory of this bremsstrahlung production process was developed, and results that are useful in estimating the feasibility of a measurement were obtained. Because of the recoil of the charged nucleus, this technique could also be used even if the incident and/or product particles are uncharged. (auth)

925

ANGULAR DISTRIBUTION FROM NUCLEAR FISSION IN RESONANCE REGION. O. Hittmair (Österreichische Hochschule, Vienna). Nuclear Phys. 18, 346-52(1960) Aug. (2). (In German)

An expression for the angular distribution of resonance fission was developed under the condition that the nucleus preserves its axial symmetry in the process of fission. This was achieved by reducing the representation product, which describes the orientation of the nuclear symmetry axis in space with respect to the entrance channel. The result is expressed in Racah coefficients and Legendre polynomials. General predictions about the symmetry of the angular distribution and the effect of polarized incident neutrons can be made. The formula was applied to the resonance fission of Th^{232} for incident 1.60-Mev neutrons, adopting the unified model. Excellent agreement with experiment was obtained if the resonance was ascribed to rotational levels of the $3/2$-band of negative parity. (auth)

926

ANGULAR DISTRIBUTIONS AND POLARIZATION IN STRIPPING PROCESSES AND IN DIRECT REACTIONS. L. J. B. Goldfarb and R. C. Johnson (Univ. of Manchester, Eng.). Nuclear Phys. 18, 353-94(1960) Sept. (1). (In English)

General expressions were found for angular distributions and polarization effects in a variety of direct reactions. These reactions include processes involving the stripping of deuterons and of heavier nuclei, in addition to inelastic scattering phenomena which arise either from individual nucleon-nucleon encounters or from collective effects at the nuclear surface. Various selection rules were found for the existence of polarization, using the distorted-wave Born approximation and allowing for spin-dependent distortions. The influence of a neighboring isolated resonance state of the compound nucleus was examined, and modifications were found of the general results. Expressions are

given for the angular correlation of the γ rays following de-excitation of the residual nucleus. (auth)

927

ON THE STATISTICAL PROPERTIES OF THE LEVEL-SPACINGS IN NUCLEAR SPECTRA. M. L. Mehta (Centre d'Études Nucléaires, Saclay, France). Nuclear Phys. 18, 395-419(1960) Sept. (1). (In English)

The level-spacing distribution was studied under the random-matrix hypothesis. Rigorous lower and upper bounds for the distribution function of the level-spacing are given. Comparison of these with Wigner's surmise shows that it is a very good approximation. It is shown, however, that it cannot be exact even in the limiting case $n \to \infty$. (auth)

928

ON THE DENSITY OF EIGENVALUES OF A RANDOM MATRIX. M. L. Mehta and M. Gaudin (Centre d'Études Nucléaires, Saclay, France). Nuclear Phys. 18, 420-7 (1960) Sept. (1). (In English)

An exact expression for the density of eigenvalues of a random matrix was derived. When the order of the matrix becomes infinite, it can be seen very directly that it goes over to Wigner's "semi-circle law." (auth)

929

DETERMINATION OF ABSOLUTE Bρ VALUES OF CONVERSION LINES. C. de Vries (Inst. of Nuclear Research, Amsterdam). Nuclear Phys. 18, 428-45(1960) Sept. (1). (In English)

A recently constructed Siegbahn-Edvarson type iron-free double focusing spectrometer was used to determine absolute Bρ-values of electron lines. The high resolution (a few parts in 10^4) and high accuracy in the line positions (about $1:10^5$) of this instrument are shown. The effects of natural line width and source thickness on the adopted line position definition were investigated. The absolute Bρ-values of some conversion lines occurring in the spectrum of the Pb^{212} active deposit (covering the energy range from 150 kev to 2.6 Mev) were determined with an accuracy of about one part in 10^4. Comparison with published results for these Bρ-values shows the linearity of the instrument to be better than $1:10^4$ for the energy region considered. (auth)

930

PRECISION MEASUREMENTS OF ENERGIES OF GAMMA-RAYS FOLLOWING THE DECAY OF SOME GOLD ISOTOPES. C. de Vries and J. H. Dijkstra (Inst. for Nuclear Research, Amsterdam). Nuclear Phys. 18, 446-53(1960) Sept. (1). (In English)

The energies of eight gamma rays occurring in the decay of some gold isotopes were determined from their conversion-line momenta as measured with an iron-free double focusing spectrometer. The Bρ-assignments to the lines following the decay of Au^{194}, Au^{196}, Au^{198} (10 h) isomer and Au^{199} were obtained by using the conversion lines of the 158 kev transition in Hg^{199} as calibration line. Absolute Bρ-values of the latter lines could be determined by applying the self-consistent method of Siegbahn. Disregarding the calibration uncertainty (about one part in 10^4) the accuracy reached in the energies of the gamma rays was about 7 parts in 10^5. The value 411.766 ± 0.028 kev for the energy of the well known E2 transition in Hg^{198} was in nice agreement with other values, some of which were determined directly with a curved crystal. (auth)

931

ABSOLUTE AND RELATIVE CONVERSION DETERMINATIONS OF PURE E2 TRANSITIONS OCCURRING IN Hg^{198}, Hg^{199}, Pt^{194}, AND Pt^{196}. C. de Vries, E. J. Bleeker, and N. Salomons-Grobben (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nuclear Phys. 18, 454-72(1960) Sept. (1). (In English)

Conversion coefficients of some pure E2 transitions following the decay of some gold isotopes were determined using an iron-free double focusing spectrometer of the Siegbahn-Edvarson type. The α_K of the 412 kev transition in Hg^{198}, the 328 kev transition in Pt^{194} and the 354 kev transition in Pt^{196} were determined using the external-internal method as recently improved by Hultberg and Stockendal. Results indicate that the theoretical values for these conversion coefficients are 10 to 20% too high. Some additional measurements made the explanation of the mentioned deviations by systematical errors improbable. Experimental relative conversion coefficients (K/L, $L_I/L_{II}/L_{III}$) of the 412 kev transition in Hg^{198} indicate the deviations found for the absolute K-conversion coefficients to be present also for the L-shells. Results for the ratios L/M of the 412 kev transition in Hg^{198} and $M_I/M_{II}/M_{III}$ of the 158 kev transition in Hg^{199} suggested a correction factor of 0.6 to be applied to the theoretical values of the conversion coefficients for the M-subshells that are not corrected for screening. (auth)

932

PROTONS FROM DEUTERON BOMBARDMENT OF Be^7. R. W. Kavanagh (California Inst. of Tech., Pasadena.). Nuclear Phys. 18, 492-501(1960) Sept. (1). (In English)

Protons from the reaction $Be^7(d,p)Be^8$ leading to Be^8 excitations up to 11 Mev were examined with a NaI(Tl) scintillation spectrometer. No groups attributable to Be^8 were observed except those corresponding to the ground state (p_0) and first excited state (p_1), along with a continuum extending to over 11 Mev excitation. Resonances were found at bombarding energies of 0.900 ± 0.025 (p_0 and p_1) and 1.475 ± 0.010 Mev (p_1 only) with center-of-mass widths 120 ± 40 and 71 ± 8 kev, respectively, corresponding to states in B^9 at 17.19 and 17.63 Mev. The excitation energy and width of the first excited state of Be^8 are $E_x = 2.90 \pm 0.06$ and $\Gamma_{cm} = 1.53 \pm 0.04$ Mev. The reduced width of this state and the $\alpha-\alpha$ interaction radius extracted from a single-level analysis were compared with those found in $He^4(\alpha,\alpha)$ and $B^{10}(d,\alpha)$ reactions. (auth)

933

LOW LEVELS OF Al^{27}. E. Almqvist, D. A. Bromley, H. E. Gove, and A. E. Litherland (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nuclear Phys. 19, 1-17(1960) Sept. (3). (In English)

The de-excitation radiation from the 0.84 and 1.013 Mev levels in Al^{27} was studied at a number of resonances in the reaction $Al^{27}(p,p'\gamma)$ with proton energies between 1.7 and 2.8 Mev. The data support assignments $\frac{1}{2}^+$ and $\frac{3}{2}^+$ to the 0.84 and 1.013 Mev states. The 1.013 Mev state was observed to be de-excited, 2.4 (±0.3)% via a 0.170 Mev transition to the 0.84 Mev level, and the remainder to the ground state. It is shown that either one or both of these radiations have an E2/M1 amplitude ratio ≳ 0.2. These results and other properties of the low levels of Al^{27} are discussed in terms of the rotational collective model, which is found to give a good qualitative description of most of the known data. (auth)

934

THE W^{187} DECAY SCHEME AND POSSIBLE VIBRATIONAL LEVELS IN AN ODD-MASS NUCLEUS. C. J. Gallagher, Jr., W. F. Edwards, and G. Manning (California Inst. of Tech., Pasadena). Nuclear Phys. 19, 18-39(1960) Sept. (3). (In English)

The transitions and levels of Re^{187} populated by W^{187}

β^- decay were investigated with a bent crystal spectrometer, an iron-free homogeneous-field spectrometer, an iron-free 180°-focusing spectrometer, and a fast-slow coincidence angular-correlation unit. Seventeen transitions, which are interpreted to establish eight excited levels in Re^{187} were observed. An analysis of the levels in terms of the Nilsson description showed that certain definite discrepancies exist between the theoretically expected level order and that observed. It is therefore suggested that two of the levels observed may correspond to the coupling of single particle states to γ vibrations. (auth)

935

MECHANISM OF THE $Zn^{64}(n,p)Cu^{64}$ REACTION AT INCIDENT NEUTRON ENERGIES OF 8 AND 14 MeV. Alice H. Armstrong and Louis Rosen (Los Alamos Scientific Lab., N. Mex.). Nuclear Phys. 19, 40-51(1960) Sept. (3). (In English)

The $Zn^{64}(n,p)Cu^{64}$ reaction was studied at incident neutron energies of 8 and 14 Mev. These experiments were part of an investigation of the adequacy of the statistical model concept of the compound nucleus to describe interactions when complex nuclei are bombarded by neutrons at energies in the region of nuclear binding energies. The spectral and spatial distributions of most of the protons indicated that the compound-nucleus hypothesis may be satisfied. The high-energy proton distributions are in sharp contrast with the predictions of the statistical model and contradict the compound-nucleus hypothesis. For 8 Mev neutron-bombarding energy, there is an inordinately large probability for the emission of protons with energies considerably lower than that of the Coulomb barrier. (auth)

936

$\beta-\gamma$ CORRELATION OF THE $3^- - 2^+ - 0^+$ CASCADE IN THE DECAY OF Eu^{152}. J. W. Sunier, P. Debrunner, and P. Scherrer (Federal Inst. of Tech., Zurich). Nuclear Phys. 19, 62-7(1960) Sept. (3). (In English)

The $\beta-\gamma$ directional correlation of the $3^- - 2^+ - 0^+$ cascade in the decay of Eu^{152} was measured as a function of β-particle energy. The anisotropy factor $\epsilon(W)$ in the $\beta-\gamma$ directional correlation $N(W,\theta) = 1 + \epsilon(W)\, P_2(\cos\theta)$ was found to be $\epsilon(3.5\ m_0c^2) = -0.46 \pm 0.02$ near maximum β energy. The nuclear matrix elements involved in the observed β transition were computed from the measured values of $\epsilon(W)$ and from the shape correction factor. The data imply that the relative contribution of the $\int B_{ij}$ matrix element is unusually large, as was expected on the basis of the large deviation from the allowed shape of the β spectrum. The reduction of the matrix elements other than $\int B_{ij}$ can be caused by a selection rule effect. (auth)

937

THE 85 MINUTE ACTIVITY OF Ba^{139}. W. H. Kelly, G. B. Beard, W. B. Chaffee, and J. M. Gonser (Michigan State Univ., East Lansing). Nuclear Phys. 19, 79-84(1960) Sept. (3). (In English)

The decay scheme of Ba^{139} was studied using scintillation detectors. The half-life was found to be 85 ± 3 min. Beta-gamma and gamma-gamma coincidence measurements showed this decay to consist of three β groups of 2.38, 2.23, and 0.95 Mev, leading to the ground state and two excited states of La^{139}, the energies of the excited states being 0.167 ± 0.003 and 1.43 ± 0.05 Mev. Transitions from these two states were to the ground state. Branching ratios of 0.72, 0.26, and 0.02 were found for the 2.38, 2.23, and 0.95 Mev β groups, respectively. Beta-gamma delayed coincidence measurements made on the 0.167 Mev state showed the half-life of this state to be 1.7 ± 0.2 ns. (auth)

938

THEORY OF E0 TRANSITIONS OF SPHEROIDAL NUCLEI. John O. Rasmussen (Univ. of California, Berkeley). Nuclear Phys. 19, 85-93(1960) Sept. (3). (In English)

The nuclear matrix elements for E0 transition probabilities associated with β-vibrational transitions of spheroidal nuclei were derived by two different models. The first model, previously studied by Peaslee and by Reiner, involved the volume-conserving quadrupole surface oscillations of a uniformly-charged spheroid about an equilibrium deformation of β. The second model summed over the coherent contributions of all the proton orbitals involved in an individual particle representation of the collective motion. The second model when corrected for volume-conservation gave about twice the ratio of E0 to E2 for Sm^{152} and Pu^{238} which was given by the first model. A brief comparison with experiment was made, showing satisfactory agreement for Pu^{238} and serious disagreement for Sm^{152}. (auth)

939

THE $Mg^{24}(\gamma,n)Mg^{23}$ REACTION. J. D. King and W. J. McDonald (Univ. of Saskatchewan, Saskatoon). Nuclear Phys. 19, 94-100(1960) Sept. (3). (In English)

The $Mg^{24}(\gamma,n)Mg^{23}$ reaction was studied by irradiating a magnesium sample in the x-ray beam of a 25 Mev betatron and measuring the Mg^{23} positron decay by coincidence detection of the annihilation radiation. The cross section had a small peak at 17.2 Mev with the giant resonance appearing at 19.2 Mev. There was a pronounced high-energy tail. These results are compared with recent investigations of the $Na^{23}(p,\gamma)Mg^{24}$ inverse photonuclear reaction. Both cross sections showed a small peak below the giant resonance region. An attempt was made to interpret the cross-section shapes in terms of the deformation of the Mg^{24} nucleus, but the results were inconclusive. (auth)

940

THE 9.63 Mev STATE OF C^{12}. F. C. Barker, E. Bradford, and L. J. Tassie (Australian National Univ., Canberra). Nuclear Phys. 19, 101-9(1960) Sept. (3). (In English)

An analysis of the data from experiments involving the 9.63 Mev state of C^{12} suggests that this state may be 3^-, and not 1^- as previously supposed. An experiment to distinguish between these possibilities is suggested. (auth)

941

CALCULATION OF SPLITTING OF $3s_{1/2}$ NEUTRON LEVELS. F. C. Barker (Australian National Univ., Canberra). Nuclear Phys. 19, 110-12(1960) Sept. (3). (In English)

A simple calculation of the separation of the levels produced by addition of a $3s_{1/2}$ neutron to an odd proton nucleus gives satisfactory agreement with the observed separation. (auth)

942

BETA DECAY OF Sr^{89}. C. Manduchi and M. T. Russo-Manduchi (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10), 17, 516-22(1960) Aug. 16. (In Italian)

An experiment for the determination of the specific shape of the interaction which controls the β decay of Sr^{89}, whose spectrum is unique first forbidden, is described. The results, obtained using angular correlation electron-neutrino measurements, show that the prevailing interaction is of the axial vector kind, without excluding, however, a possible contribution from the interaction of tensor kind not greater than 26%. (auth)

943

THE GAMMA RAY SPECTRA OF ^{65}Ni AND ^{65}Zn. CHAR-

ACTERISTICS OF THE LOWER EXCITED STATES OF ^{65}Cu. R. A. Ricci (Universita, Naples and Istituto Nazionale di Fisica Nucleare, Naples), G. Chilosi, G. Varcaccio, G. B. Vingiani, and R. van Lieshout. Nuovo cimento (10), 17, 523-34(1960) Aug. 16. (In English)

The γ spectra of Ni^{65} and of Zn^{65} were studied by means of scintillation techniques. It is shown that the first excited state of Cu^{65} at 770 kev is not populated in either of the decays. In Ni^{65} (half-life: (2.50 ± 0.03) h) two new γ rays of (1.63 ± 0.05) and (1.73 ± 0.05) Mev were found, which originate at levels of the same energy known to exist in Cu^{65}. Evidence is presented that the level at 1.482 Mev does not belong to the quartet of levels arising from the coupling of the 29th proton ($p_{3/2}$) to the Ni^{64} core in its first excited 2^+ state (at 1.34 Mev), as assumed by Lawson and Uretsky in their application of the center-of-gravity theorem to Cu^{65}. Agreement with this theorem was obtained for certain spin assignments to the other four excited states in Cu^{65} below 2 Mev. (auth)

944

A MEASUREMENT OF THE TOTAL ABSORPTION RATE OF MUONS IN CARBON. F. Russell Stannard (Univ. of California, Berkeley). Nuovo cimento (10), 17, 599-606 (1960) Aug. 16. (In English)

Negative muons stopped in a propane bubble chamber form mesic atoms with carbon nuclei. Subsequently they either decay by their usual mode or interact with the nucleus. Based on a sample of 2519 mesons, the probability for interaction was found to be (7.4 ± 0.8)%, and the total absorption rate of muons in carbon became (0.36 ± 0.04) · 10^5 s^{-1}. The result was found to be in satisfactory agreement with theory. (auth)

945

THE ATOMIC WEIGHTS OF IRON-52 AND MANGANESE-52m. Jose O. Juliano (Philippine Atomic Energy Commission, Manila). Philippine J. Sci. 88, 217-19(1959) June.

Closed-cycle and energy-balance calculations are useful in predicting properties of nuclides. With these calculations it is possible to determine accurately the atomic masses of unstable nuclides that, because of their short half-lives, make direct spectrographic determinations quite difficult. The masses thus determined may be used to study nuclear energy surface thermodynamics and in related theoretical studies of nuclear structures. With these principles and recent data for mass-52 isobars, viz., the decay of Fe^{52}, the masses of Fe^{52} and Mn^{52m} were recalculated. The proposed masses for the mass-52 isobars are tabulated and compared to results by Bainbridge and Wapstra. A revised nuclear decay scheme for Fe^{52}, Mn^{52m}, and V^{52} is illustrated. Since no previous data can be found for the mass of Mn^{52m} (51.96239 amu), it is felt that this value is quite accurate. (B.O.G.)

946

UPPER BOUND ON TOTAL ELECTRON SCATTERING CROSS SECTIONS IN HYDROGEN. Nicholas A. Krall and E. Gerjuoy (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev. 120, 143-4(1960) Oct. 1.

Dispersion relations for electron-hydrogen scattering were combined with existing scattering length calculations. The sign of the scattering length was shown to give an upper bound on $\int\sigma(k)dk$ where $\sigma(k)$ is the total cross section for scattering of electrons of incoming momentum $\hbar k$. Recent calculations of the scattering length were used to determine this limit. An experiment by Fite et al., satisfied this bound, agreeing with the recent calculations of the scattering length. (auth)

947

DECAY OF Pm^{149} (53 hr). L. C. Schmid and S. B. Burson (Argonne National Lab., Ill.). Phys. Rev. 120, 158-61(1960) Oct. 1.

The radioactive sources were obtained from neodymium oxide, enriched in Nd^{148}, irradiated in the Argonne reactor CP-5. After the 1.8-hr activity of Nd^{149} decayed away, the 53-hr activity of $_{61}Pm^{149}$ remained. Some of the samples were purified by ion-exchange-column techniques before being studied. The radiations were investigated with a 180° focusing β-ray spectrometer and the Argonne 256-channel scintillation coincidence spectrometer. The magnetic spectrometer resolved two components of the β spectrum at 1.064 ± 0.008 and 0.784 ± 0.010 Mev. The β rays were also studied by coincidence absorption techniques. In addition to the branch with a maximum energy of 0.784 ± 0.010 Mev, this method revealed two more at 0.47 ± 0.04 and 0.19 ± 0.04 Mev. The scintillation pulse-height spectrum of the γ rays revealed the presence of three transitions at 0.850 ± 0.008, 0.582 ± 0.006, and 0.285 ± 0.001 Mev. A fourth γ ray with an energy of 0.548 ± 0.006 Mev was found in coincidence measurements. These radiations were fitted into a decay scheme comprising the ground state and four excited states in Sm^{149} at 0.285, 0.582, 0.833, and 0.850 Mev. The log-ft values, transition intensities, and possible spin and parity assignments are discussed. (auth)

948

LIFETIMES OF THE FIRST EXCITED STATES OF F^{17} AND O^{17}. J. V. Kane, R. E. Pixley, R. B. Schwartz, and A. Schwarzschild (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 120, 162-8(1960) Oct. 1.

Using the γ-γ coincidence method and an electronic time-to-amplitude converter, the lifetimes of the first excited states in the mirror pair O^{17}(0.87 Mev) and F^{17}(0.50 Mev) were measured. The reactions initiating the γ cascades were $O^{16}(d,p)O^{17}$ and direct proton capture in O^{16}. The time resolution of the coincidence circuit was good enough to allow the lifetime measurements to be made by direct observation of the exponential decay, rather than by measurement of the centroid shift. The measured mean life of O^{17} is (2.55 ± 0.13) × 10^{-10} sec; the measured mean life of F^{17} is (4.45 ± 0.22) × 10^{-10} sec. Both of these results are in reasonable agreement with earlier, less accurate values. (auth)

949

COLLECTIVE QUADRUPOLE EFFECTS IN LIGHT NUCLEI. B. James Raz (State Univ. of New York, Oyster Bay). Phys. Rev. 120, 169-74(1960) Oct. 1.

The recent measurements of the lifetimes of the first excited states of the mirror nuclei O^{17} and F^{17} raised new interest in the various theoretical interpretations of these lifetimes. The weak-coupling collective model of Bohr and Mottelson was applied to these E2 transitions and to the similar E2 transitions that were measured in N^{16}, F^{19}, and Ne^{19}. If harmonic oscillator radial wave functions were used in evaluating the radial integrals in the theory, the predictions matched the experimental results for the E2 transition probabilities in N^{15}, O^{17}, F^{17}, and F^{19} and the quadrupole moment of O^{17}. The theoretical prediction was an order of magnitude smaller than the experimental result for transition probability of the first excited state of Ne^{19}. (auth)

950

RESONANT SCATTERING OF X RAYS FROM MAGNESIUM AND SILICON. Ralph A. Tobin (U. S. Naval Research Lab., Washington, D. C.). Phys. Rev. 120, 175-80 (1960) Oct. 1.

Energy levels at 10.15 ± 0.06 Mev in magnesium and 11.40 ± 0.06 Mev in silicon were studied using resonant scattering from a continuous spectrum of x rays by samples of these materials. Using tentative spin assignments and assuming no branching, level widths of 4.80 (+1.6, −1.4) ev and 2.89 (+1.0, −0.8) ev for magnesium and silicon, respectively, were determined from absorption measurements. (auth)

951

PARITY-NONCONSERVING INTERNUCLEON POTENTIALS. II. EFFECTS IN ELECTROMAGNETIC TRANSITIONS. R. J. Blin-Stoyle (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 120, 181-9(1960) Oct. 1.

A detailed investigation was made of the way in which parity-nonconserving (PNC) internucleon potentials lead to parity impurities in nuclear states and hence to pseudoscalar asymmetries in the emission of γ radiation. Explicit expressions were obtained for the angular distribution of unpolarized radiation in emission from nuclei polarized by non-nuclear methods, in β-γ angular correlations, in polarized thermal-neutron capture radiation, and also for the magnitude of the circular polarization of radiation from an arbitrarily oriented nuclear system. The magnitudes of these effects were then estimated for the case of a transition between low-lying nuclear states and also for a ground-state transition following neutron capture. Finally a critique of the γ-ray transitions so far used in experimental investigations of PNC effects is given. It is concluded that many transitions in particularly simple nuclei are insensitive to PNC effects and that at present all that can be stated with any confidence is that the ratio PNC to PC $\leq 10^{-4}$ to 10^{-5}. (auth)

952

TRANSITION INTENSITIES IN THE Tl^{208} BETA DECAY, THE $Bi^{212} \rightarrow Po^{212}$ DECAY SCHEME, AND THE Bi^{212} BRANCHING RATIO. G. Schupp, H. Daniel, G. W. Eakins, and E. N. Jensen (Ames Lab., Ames, Iowa). Phys. Rev. 120, 189-98(1960) Oct. 1.

Studies were made on the Pb^{212} (ThB) active deposit by means of γ singles and β-γ, γ-γ, γ-α, and γ-γ-α coincidence measurements. The singles and coincidence γ-ray spectra were recorded on an RCL 256-channel analyzer, and an intermediate-image β-ray spectrometer was used in the β-γ work. Beta intensities of 4.6 ± 0.2, 23.9 ± 0.8, 22.7 ± 0.7, 48.8 ± 2.7, and <0.5% were obtained for the 1.04, 1.29, 1.52, 1.80, and 2.38 Mev groups, respectively, in the $Tl^{208} \rightarrow Pb^{208}$ decay. Existence of the 1.800 Mev γ ray in Po^{212} was established and 11.2 ± 0.7% of the $Bi^{212} \rightarrow Po^{212}$ disintegrations were determined to go by way of the 0.727 Mev transition. Relative intensities of 11.1 ± 0.7, 1.7 ± 0.3, 0.66 ± 0.07, 0.16 ± 0.04, 0.99 ± 0.08, 0.49 ± 0.05, 2.8 ± 0.2, and 0.17 ± 0.03 were found for the 0.727, 0.786, 0.893, 0.953, 1.073, 1.513, 1.620, and 1.800 Mev γ rays, respectively, in Po^{212}. The ratio of α to total disintegrations for the Bi^{212} decay was measured to be 0.3596 ± 0.0006. (auth)

953

ANGULAR DISTRIBUTION OF FRAGMENTS IN FISSION INDUCED BY MEV NEUTRONS. J. E. Simmons and R. L. Henkel (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 120, 198-210(1960) Oct. 1.

A multiangle gas-filled counter was used to measure the fragment angular distribution in fission induced by neutrons in the energy range $0.5 \leq E_N \leq 9$ Mev. The target nuclei used were: Th^{230}, U^{233}, U^{234}, U^{235}, U^{236}, U^{238}, Np^{237}, and Pu^{239}. In the cases of U^{233} and U^{235} the neutron energy range was extended to include energies between 14.8 and 23 Mev. The general features of these data are the following: The anisotropy (0° : 90° intensity ratio) had values between 1.1 and 1.2 depending on the target and is roughly independent of energy for E_N between 2 and 5.5 Mev. At higher energies a rise was observed such that at 7 Mev even-odd targets gave values of anisotropy in the range 1.2 to 1.3 while even-even targets showed greater values in the range 1.6 to 2.2. The anisotropy decreased somewhat at 9 Mev. Near thresholds for the even-even target nuclides, considerable fluctuations of anisotropy were observed. The example of U^{236} at 0.85 Mev showed a new case of minimum intensity at 0°, the anisotropy being 0.64. In the energy region 2 to 4 Mev, the anisotropy of Pu^{239}, U^{233}, and U^{235} increased by a few percent from one to the next as the spin increased. This is contrary to simple theoretical expectations. These data were compared to recent theoretical developments of the Bohr model as given by Griffin and by Halpern and Strutinski. The theory provides a satisfactory account of many features of the data. (auth)

954

$B^{10}(d,p)B^{11}$ REACTION AND THE CONFIGURATIONS OF B^{11}. O. M. Bilaniuk and J. C. Hensel (Univ. of Michigan, Ann Arbor). Phys. Rev. 120, 211-23(1960) Oct. 1.

A study of the states of B^{11} was made by high-resolution measurements of angular distributions and relative intensities of proton groups from $B^{10}(d,p)B^{11}$. The use of Butler analysis and calculated reduced widths leads to the following spin and parity assignments for excited states: 2.14 Mev, $\frac{1}{2}-$; 4.46 Mev, $\frac{5}{2}-$; 5.03 Mev, $\frac{3}{2}-$; 6.76 Mev, $\frac{7}{2}-$; 8.57 Mev, $(\frac{1}{2}+)$; 8.92 Mev, $\frac{5}{2}+$; 9.19 Mev, $\frac{7}{2}+$; and 9.28 Mev, $\frac{5}{2}+$. The states of B^{11} exhibit a subdivision into three classes. The first five levels from ground state to 6.76 Mev, all of odd parity, correspond closely to the theoretical predictions of Kurath. The next four states of 6.81, 7.30, 7.99, and 8.57 Mev presumably result from highly mixed configurations which are evidenced by their weak stripping intensities. The third group consists of three single-particle states of even parity at 8.92, 9.19, and 9.28 Mev. The latter two states form a jj-double level arising from the configuration $p^6 2s$. (auth)

955

ENERGY LEVELS OF He^5 AND Li^5. L. D. Pearlstein, Y. C. Tang, and K. Wildermuth (Florida State Univ., Tallahassee). Phys. Rev. 120, 224-34(1960) Oct. 1.

The energies of the first three levels in He^5 were determined using a variational procedure. The various wave functions adopted incorporated alpha, triton, and deuteron correlations. It was determined that the ground state $\frac{3}{2}-$ must be an α-neutron configuration whereas the $\frac{1}{2}-$ level, which must also be described by this configuration, is not a sharp resonant state. The $\frac{3}{2}+$ level at 16.69 Mev is shown to be a deuteron–triton configuration. The resultant energies and structures of these levels are in accord with the experimental situation. It should be stressed that our wave functions differ appreciably from the standard shell-model ones in the intermediate-coupling picture. (auth)

956

ATOMIC MASSES IN THE HEAVY MASS REGION. V. B. Bhanot, W. H. Johnson, Jr., and A. O. Nier (Univ. of Minnesota, Minneapolis). Phys. Rev. 120, 235-51(1960) Oct. 1.

A 6-in. double-focusing mass spectrometer was employed to determine 61 mass doublets in the region of gadolinium to gold. The present results and other Minnesota mass data were combined with nuclear reaction, β decay, and α decay energies in order to construct a mass table for more than 200 stable and radioactive isotopes in the region from samarium to radon. Total atomic binding en-

ergies as well as nucleon separation and pairing energies were computed, wherever possible. The present data confirm with greater detail the previously reported anomalies in the nucleon separation and pairing energies in the regions around 90 neutrons and 116 neutrons. The proton pairing energies were found to show rather pronounced "maxima" around N = 88 and N = 116, a behavior similar to the previously reported behavior of neutron pairing energies. The nature of the discontinuities in these two regions did not appear to follow the patterns found at major shell closures but seemed to be caused by a change in the nuclear structure in these regions. It is known that such a change is indicated also by other nuclear properties. Major discontinuities connected with the shell closures at Z = 82 and N = 126 were brought out in greater detail than had previously been possible. The mass data were also employed for the study of isotopic assignments for several nuclear reactions in this region. (auth)

957

GAMMA RAYS FROM THE PROTON BOMBARDMENT OF NATURAL SILICON. L. W. Seagondollar, Gale I. Harris, and L. Kasturi Rangan (Univ. of Kansas, Lawrence). Phys. Rev. 120, 251-3(1960) Oct. 1.

The γ-ray yield curve was observed when thin targets of natural silicon were bombarded with monoergic protons in the energy range of 300 to 1840 kev. In order to take small steps in proton energy, a target potential modulation technique was used. Fifty-five resonances were observed, all but fifteen of which were observed elsewhere using targets enriched in Si^{29} or Si^{30}. The fifteen resonances at 369, 1096, 1134, 1204, 1290, 1382, 1472, 1484, 1507, 1570, 1598, 1617, 1625, 1630, and 1653 kev are presumed due to the Si^{28} + p reaction. (auth)

958

APPLICATION OF THE PHASE SPACE QUASI-PROBABILITY DISTRIBUTION TO THE NUCLEAR SHELL MODEL. George A. Baker, Jr. (Los Alamos Scientific Lab., N. Mex.), Ian E. McCarthy, and Charles E. Porter. Phys. Rev. 120, 254-64(1960) Oct. 1.

The quantum mechanical joint position-momentum quasi-distribution function was applied to the nuclear shell model. By introducing approximate quasi-position and quasi-momentum variables, the quasi-distribution function was converted into a non-negative (and hence nonquasi) distribution. Numerical results are presented for one-dimensional and three-dimensional potentials leading in three dimensions to a nonisotropic nonindependent distribution with a predominance of low momenta at the nuclear surface. The results are in contrast with the usual Thomas-Fermi model and in addition provide a simple base for the discussion of direct nuclear reactions involving an average over many states of a residual nucleus for which linear momentum as opposed to angular momentum is a relevant quantity. (auth)

959

SPIN AND PARITY ASSIGNMENTS TO THE E_p = 504 keV AND E_p = 506 keV RESONANCE LEVELS IN $^{27}Al(p,\gamma)^{28}Si$. P. B. Smith and J. Kuperus (Rijksuniversiteit, Utrecht). Physica 26, 631-2(1960) Aug. (In English)

The resonance doublet of $Al^{27}(p,\gamma)Si^{28}$ at E_p = 504 and 506 kev was investigated with the Utrecht 850-kev cascade generator, and the following results were obtained. The angular distribution of the ground-state transition of the 504-kev level is $W(\theta) \sim 1 + (0.01 \pm 0.02)\cos^2\theta$, and that of the first excited state transition of the 506-kev level is $W(\theta) \sim 1 - (0.08 \pm 0.02)\cos^2\theta$. Both levels decay to both the ground state (0^+) and the first excited state (2^+) of Si^{28}. The 504-kev level emits α particles to the ground state of $Mg^{24}(0^+)$, whereas the 506-kev level does not. It is concluded that the spins and parities of the 504-kev and 506-kev resonance levels are 2^+ and 1^+, respectively; the reasons for these assignments are given. (D.L.C.)

960

INVESTIGATION OF THE $He^3 + H^3$ REACTION. Ka-yehn Li, G. M. Osetinskiĭ, S. Sodnom, A. M. Govorov, I. V. Sizov, and V. I. Salatskiĭ (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 225-9 (1960) Aug. (In Russian)

The total cross section for the reaction $He^3 + H^3$ was determined for triton energies of 150 to 970 kev with a thin gaseous target. In the indicated energy range, the total cross section increases from 3.2 to 63.0 mb. The ratios of the cross sections for various branches of the reaction were measured as a function of the energy. The energy of decay of He^5 into an α particle and a neutron was determined. (auth)

961

INVESTIGATION OF SECONDARY (α, xn) REACTIONS IN BISMUTH. Yung-yü Wang, V. V. Kuznetsov, M. Ya. Kuznetsova, and V. A. Khalkin (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 230-4(1960) Aug. (In Russian)

The absolute production cross sections and relative yields of At^{210} and At^{211} from bismuth irradiated by 120- to 660-Mev protons were determined by a radiochemical method. In the given case the astatine isotopes were produced in the (α, xn) reaction during capture by the target nucleus of α particles with energies $E_\alpha > 20$ Mev produced as a result of disintegration. The cross sections for production of α particles with energies $E_\alpha > 20$ Mev were computed on the basis of experimental data. The shape of the energy spectrum was estimated. (auth)

962

INSTABILITY OF A SYSTEM OF EXCITED OSCILLATORS WITH RESPECT TO ELECTROMAGNETIC PERTURBATIONS. A. V. Gaponov (Inst. of Radiophysics, Gor'kiĭ State Univ., USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 326-31 (1960) Aug. (In Russian)

Possible mechanisms of excited-oscillator autophasing in a radiation field, leading to instability of the system with respect to electromagnetic disturbances, are considered. It is shown that from the quantum point of view the instability of such systems may be due to unequal spacing of the (anharmonic) oscillator spectrum or to recoil during the emission of a photon. (auth)

963

INVESTIGATION OF THE (n,p)-REACTION ON THE Li^6 NUCLEUS. I. Sh. Vashakidze, T. I. Kopaleĭshvili, and G. A. Chilashvili (Inst. of Physics, Academy of Sciences, Georgian SSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 393-6 (1960) Aug. (In Russian)

The angular distribution of protons produced in the n-p reaction in Li^6 was derived by taking into account the neutron-proton correlation within the nucleus under consideration. (auth)

964

POLARIZATION OF PROTONS SCATTERED ON O^{16}. K. V. Karadzhev and V. I. Man'ko. Zhur. Eksptl'. i Teoret. Fiz. 39, 416-17(1960) Aug. (In Russian)

The polarization of 3 to 4.5 Mev protons elastically scattered on O^{16} is calculated for three angles: 60, 90, and 120°. It is shown that the polarization is very sensitive to the choice of the level parameters of the F^{17} nucleus. (auth)

965
CONTRIBUTION TO THE THEORY OF OPTICAL ANISOTROPY OF ATOMIC NUCLEI. A. M. Baldin and S. F. Semenko (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz. 39, 434-7(1960) Aug. (In Russian)

Elastic scattering of γ quanta on oriented nuclei is considered. The possibility of an experimental study of nuclear optical anisotropy parameters including the vector electric dipole polarizability of nuclei is discussed. (auth)

966
PROBABILITIES FOR ROTATIONAL γ-TRANSITIONS OF THE E2 TYPE AND THE QUADRUPOLE MOMENTS OF DEFORMED NUCLEI WITH K = 1 and K = ½. D. A. Varshalovich (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz. 39, 461-2(1960) Aug. (In Russian)

Expressions for B(E2) and Q are given for those cases when these quantities not only depend on the direct matrix element but on the cross element as well. (auth)

967
LIMITS OF STABILITY AND PROTON AND TWO-PROTON RADIOACTIVITY OF NEUTRON-DEFICIENT ISOTOPES OF LIGHT NUCLEI. V. I. Gol'danskiĭ (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz. 39, 497-501(1960) Aug. (In Russian)

Application of isotopic-invariance principles to light nuclei yields a very simple relation between the neutron and proton binding energies in distant mirror nuclei. On the basis of this relation the limits of stability of neutron-deficient isotopes of light nuclei with respect to proton emission can be established and the existence and properties of approximately 90 such isotopes can be predicted. Nuclei are indicated for which proton radioactivity or the very specific phenomenon of two-proton radioactivity can be observed. The chief properties of this interesting phenomenon are analyzed. (auth)

Particle Accelerators

968 UCRL-Trans-593(L)
NEW ARRANGEMENTS OF THE 1100-KV ACCELERATING EQUIPMENT OF THE ISTITUTO SUPIORE DI SANITA. M. Ageno, M. Chiozzoto, and R. Querzoli. Translated by Mary Kilpatrick from Rend. ist. super. sanità 14, 509-29 (1951). 6p. JCL.

An Oliphant ion source in which the channel rays are capable of functioning at 50 kv is described. Source signals and controls are described, and a schematic is included. (J.R.D.)

969
HIGH-FREQUENCY BEAM STORAGE IN CYCLIC ACCELERATORS. A. N. Lebedev. Atomnaya Energ. 9, 189-93 (1960) Sept. (In Russian)

Perturbations in high-frequency beam storage in accelerators with constant magnetic fields are considered. Perturbation results in increased particle scattering and in variations of mean particle energy. The general development and solution of the problem for several special cases are discussed. (tr-auth)

970
A HIGH INTENSITY NEUTRON GENERATOR. S. K. Mukherjee, N. K. Majumder, and A. Ganguly (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys. 34, 307-20 (1960) July.

A 400-kv deuteron d-c accelerator of Cockcroft-Walton type, for production of neutrons by d–d and d–t reactions, is described. Special features and principal operating characteristics of this generator are discussed. (auth)

971
ON AZIMUTHAL INSTABILITIES OF CIRCULATING CURRENTS. I. M. Samoĭlov and A. A. Sokolov. Zhur. Eksptl'. i Teoret. Fiz. 39, 257-9(1960) Aug. (In Russian)

Experimental data are presented which indicate that circulating currents are unstable and break into clusters equally spaced with respect to the azimuth. Within these clusters, conditions exist which are suitable for the appearance of peculiar radial-phase oscillations. A result is that in a collision with the injector or chamber wall, effective capture of the electrons takes place in betatron type instruments. (auth)

Plasma Physics and Thermonuclear Processes

972 AFOSR-TN-60-687
Oslo. Universitetet. Institutt for Teoretisk Astrofysikk. ON OSCILLATIONS IN AN ELECTRON PLASMA. Scientific Report No. 4. Asbjørn Kildal. 1959. 27p. Contract AF61(052)-49.

The works of Vlasov, Landau, and Van Kampen on classic plasma-oscillation theory are reviewed. The integral expression for the dispersion relation of plane waves moving through a plasma is considered. It is shown that the results of the authors mentioned may be obtained by expressing the perturbation in electron density in two different ways, using the ordinary equation of motion in the one case and the proper Maxwellian equations in the other. Elimination of the density variation from both equations yields the desired dispersion relation. The same method is applied to the case when an external magnetic field is present. The dispersion relation as found by Gross on solving Boltzmann's equation is then obtained, and the frequency gaps are studied. (auth)

973 AFOSR-TN-60-1042
Oxford Univ. Engineering Lab.
ELECTRO-MAGNETIC RADIATION IN ANISOTROPIC MEDIA. Technical Note No. 6. Herwig Kogelnik. June 1960. 67p. Contract AF61(514)-1183.

The conditions which must be satisfied by the elements of the tensor material constants of lossy (and lossless) media are studied. The duality between ferrites and plasmas, which permits the application of results obtained for one of the two media to the other by means of certain substitutions, is discussed. Plane electromagnetic waves in unbounded lossy (and lossless) anisotropic media are investigated. Wave matrices are defined, the zeros of whose determinants determine the propagation constants of the two wave types which are possible for a given direction of propagation. Formulas for the propagation constants and the polarization of waves in a plasma are derived. A general method is presented for solving radiation problems in unbounded, homogeneous, anisotropic media; this method involves dyadic Green's functions and their spatial Fourier transforms. It is shown that the latter can be described in terms of the inverse wave matrices. The elements of these transforms are computed for the case of a plasma. Formulas are derived which give the power radiated by any distribution of alternating electric and/or magnetic currents in terms of the spatial Fourier transforms of the Green's functions and the currents. The amount of power radiated per unit length of a current distribution and that radiated per unit area are discussed. The method is applied to the study of the waves excited by oscillating dipoles arranged in a plane in an anisotropic medium and

particularly in a plasma. In another application an expression is obtained for the power transferred from a modulated flat beam of ions to the plasma into which it is being injected. This latter device can be used to heat a thermonuclear plasma. The power radiated by an elementary electric dipole in a lossless plasma is studied in greater detail. The dependence of this power on the dipole's orientation and polarization can be described by means of a Hermitian matrix. Integral representations for the elements of this matrix are obtained. For special cases of anisotropy, including the case of the uniaxial crystal (or a plasma in a "very high" magnetic field), these integrals can be evaluated elementarily. For general cases of anisotropy they have been evaluated numerically for a set of parameters with the aid of an electronic computer. The power radiated by an elementary magnetic dipole is also investigated. (auth)

974 AFSWC-TR-59-63
Republic Aviation Corp. Missile Systems Div., Mineola, N. Y.
CYCLOTRON RADIATION FROM A MAGNETIZED ELECTRON GAS IN THERMAL EQUILIBRIUM. H. Rosner. Sept. 1959. 54p. Project No. 7811. Contract AF29(601)-1218. (MSD-206-954).

The radiation intensity per unit volume of nonrelativistic electron gas in thermal equilibrium is investigated in the presence of a magnetic field. The derivation is carried out by means of two conceptually different processes. Expressions are obtained for the rate of radiation loss per unit volume. The spectral properties of the nonrelativistic radiation are then investigated, with the result that only the first spectral component is significant. The radiative contributions of mixed-in relativistic electrons of a given mean energy are examined for both total and spectral intensities. The radiation of these relativistic electrons is shown to be principally in directions transverse to the magnetic field. (auth)

975 AFSWC-TR-59-65
Republic Aviation Corp. Missile Systems Div., Mineola, N. Y.
EXPERIMENTAL RESEARCH ON EXPANDING PLASMAS AND PLASMOIDS. B. Raab. Nov. 9, 1959. 34p. Project No. 7811. Contract AF29(601)-1218. (MSD-206-956).

A series of experiments with the plasma button-gun is described. These experiments were performed under the conditions of vanishing external magnetic field and chamber pressures less than 10^{-5} mm of mercury. A floating double-probe system is described, which was employed to measure plasma propagation velocity and linear dimension. Probe measurements indicated that the plasma from the button-gun expanded rapidly to fill the experimental chamber. These experiments serve to support the theoretical studies indicating the impossibility of self-confinement of plasmoids. (auth)

976 JPL-TR-32-16
California Inst. of Tech., Pasadena. Jet Propulsion Lab.
QUANTUM CORRECTIONS TO THE DISPERSION RELATION OF LONGITUDINAL OSCILLATIONS IN AN ELECTRON PLASMA. Oidwig von Roos. Apr. 30, 1960. 21p. Contract NASw-6.

An equation is derived which is a quantum mechanical analog of the classical collisionless Boltzmann equation. Quantum corrections to the dispersion relation of longitudinal plasma oscillations are evaluated for a low-density plasma, and it is found that the leading contribution ($\sim\hbar^2$) is due to exchange (Pauli-principle). (auth)

977 R60SD300
General Electric Co. Missile and Space Vehicle Dept., Philadelphia.
BIBLIOGRAPHY ON MAGNETOHYDRODYNAMICS. L. Chasen. Apr. 15, 1960. 18p. (AD-235868).

A search was conducted of open literature and documentary references, which were published from 1954 to 1959, in the areas of magnetohydrodynamics, plasma physics, electric-discharge plasmas, and high-temperature research. A total of 195 references are listed alphabetically by author or corporate author. (J.R.D.)

978 UCRL-5651-T
California. Univ., Livermore. Lawrence Radiation Lab.
END-LOSSES FROM MIRROR MACHINES. John E. Roberts and Marlene L. Carr. Apr. 1960. 83p. Contract W-7405-eng-48. OTS.

A theoretical treatment of the loss of plasmas from the ends of magnetic mirror machines, based on the Fokker-Planck equation is given. The plasma losses are described in terms of the evolution in time of distribution functions. Some supplementary calculations based on these distribution functions were made. These include charge-exchange-reaction rates and fusion-reaction rates for the DD and DT reactions. (auth)

979 UCRL-5904
California. Univ., Livermore. Lawrence Radiation Lab.
P-4, A STEADY-STATE PLASMA SYSTEM. Andrew L. Gardner, William L. Barr, Duane M. Gall, Laurence S. Hall, Raymond L. Kelly, and Norman L. Oleson. May 1960. 42p. Contract W-7405-eng-48. OTS.

A description is given of P-4, a system which produces a helium plasma with the following features: steady-state operation, nearly complete ionization (>95%), electron density of about $2 \times 10^{13}/cm^3$, small macroscopic currents, and ion temperatures up to 8 ev. The equipment and the plasma are described, and the processes involved in the operation are interpreted. (W.D.M.)

980 UCRL-9239
California. Univ., Berkeley. Lawrence Radiation Lab.
EXPERIMENTS WITH PULSED MAGNETIC CUSPS. Jean-Paul H. Watteau. May 26, 1960. Changed from OFFICIAL USE ONLY Aug. 31, 1960. 17p. Contract W-7405-eng-48. OTS.

Experiments with a simple pulsed magnetic field in cusped geometry are described. The plasma is generated inside the containment region rather than injected from an external source. It was found that creation of the plasma by a linear pinch discharge is most successful. Only qualitative studies have been carried out so far, using time-resolved visual observation of the plasma. Well-defined plasma bodies located in the central region between coils were photographed. In order to make them clearly visible, a small percentage of argon was added to the hydrogen. (auth)

981 USCEC-79-201
University of Southern California, Los Angeles. Engineering Center.
MICROWAVE MEASUREMENT OF ELECTRON DENSITY DISTRIBUTIONS IN PLASMA COLUMNS. Gordon E. Stewart and Zohrab A. Kaprielian. July 29, 1960. 45p. Contract AF49(638)-522. (AFOSR-TN-60-927).

A microwave method is described for the measurement of electron-density distributions in plasma columns. The radial dependence of the electron density is represented in terms of a series of orthogonal polynomials of the radius, the coefficients of which are evaluated by the shift

in frequency of resonance of microwave cavity modes. (C.J.G.)

982 AEC-tr-4277

CHECKING THE APPLICABILITY OF THE PROBE METHOD TO THE MEASUREMENTS OF THE CHARGE CONCENTRATION IN A HIGH-FREQUENCY DISCHARGE. S. M. Levitskiĭ and I. P. Shashurin. Translated by Lydia Venters (Argonne National Lab.) from Radiotekh. i Elektron. 4, 1238-43(1959). 10p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 12303.

983

THE PLASMA THERMOCOUPLE. DIRECT TRANSFORMATION OF FISSION ENERGY INTO ELECTRICAL ENERGY. Jacqueline Juillard. Inds. atomiques 4, No. 7-8, 75-8(1960). (In French)

The bimetallic thermocouple is a classical instrument often utilized in the measurement of temperatures. In the plasma thermocouple, one of the metals is replaced by an ionized metallic gas, and uranium fission is used as the heat source inside the cell. The results of the first investigations on the characteristics of the plasma thermocouple are briefly reviewed. (J.S.R.)

984

NEW INFORMATION CONCERNING MAGNETIC FIELD INFLUENCE ON IONS LEAVING PLASMA IN HELIUM AND ARGON. I. A. Vasil'eva, V. L. Granovskiĭ, and A. F. Chernovolenko. Radiotekh i Elektron. 5, 1508-15(1960) Sept. (In Russian)

The classical dependence of ion leakage from a plasma on the magnetic field is disturbed during field interactions. The abnormality appears earlier with stronger gas currents. Disorderly current oscillations (noises) increase the rate of ion escape, whereas regular oscillations do not cause irregularities. The influence of carrier motion toward the tube walls and of a metallic partition inserted perpendicular to the magnetic field does not influence ion escape. The partition does not effect the accuracy of the experiment (1 to 2%) with ion escape at $B/p < 5 \times 10^5$ gauss/mm Hg. (R.V.J.)

985

PLASMA OSCILLATIONS IN AN EXTERNAL STATIC MAGNETIC FIELD. S. Chulli and M. Miky. Rev. phys. Acad. rép. populaire Roumaine 3, 211-18(1958). (Translated from Referat. Zhur. Fiz. No. 3, 1960, abstract No. 6567)

Using the Boltzmann kinetic equation, the function of static charge distribution in a gas and small derivations from this distribution were investigated. The stationary solution was considered for a cylindrical symmetrical plasma. It was proposed that the deviation from the stationarity was due only to the electrons. In this case it was possible to separate the variables, and this led to a Maxwellian velocity distribution and to a spatial part, which varied at large distances as $1/r^4$. In view of the assumed smallness of the deviation from the equilibrium position, the disturbances of the plasma were taken into account only in the deviations of first-order moments (from Maxwellian distribution), while higher-order moments were approximated by moments calculated with the aid of the Maxwellian distribution of the stationary state. The equations were linearized, and a system of differential equations was obtained for the Fourier components of the magnetic field. The asymptotic form of the solutions to these equations was investigated. The dispersion relations were obtained by reconciling this asymptotic solution with the regular solution at the origin.

986

ON THE EXCITATION SPECTRUM OF AN ELECTRON AND ION SYSTEM IN A HOMOGENEOUS MAGNETIC FIELD. V. A. Yakovlev and A. V. Kalyush (Stalingrad Pedagogical Inst., USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 308-10(1960) Aug. (In Russian)

The effect of a magnetic field on the spectrum of the acoustic branch of excitations of an electron and ion system is studied with aid of the quantum kinetic equation. (auth)

987

DYNAMIC STABILIZATION OF A PLASMA RING. S. M. Osovets. Zhur. Eksptl'. i Teoret. Fiz. 39, 311-16(1960) Aug. (In Russian)

A method is proposed for the dynamic stabilization of long-wave instabilities of a plasma filament. The stability conditions are presented and the frequency range of the rapidly varying stabilizing magnetic fields is determined. (auth)

988

BUILD-UP OF ION ACOUSTIC VIBRATIONS IN ANISOTROPIC PLASMA. A. V. Timofeev. Zhur. Eksptl'. i. Teoret. Fiz. 39, 397-9(1960) Aug. (In Russian)

Vibrations of an anisotropic plasma located in a magnetic field are investigated for small values of $\beta = 8\pi nT_{\perp}/H^2$. It is found that in this case the ion acoustic waves may be unstable. (auth)

989

BUILD-UP OF MAGNETOHYDRODYNAMIC WAVES IN A PLASMA MOVING THROUGH AN IONIZED GAS. V. P. Dokuchaev (Inst. of Radiophysics, Gor'kiĭ State Univ., USSR). Zhur. Eksptl'. i Teoret. Fiz. 39, 413-15(1960) Aug. (In Russian)

A dispersion equation is derived which describes the propagation of electromagnetic waves in a plasma moving through an ionized gas. The case of low frequencies (below the gyrofrequency of the ions), when the waves degenerate into magnetodynamic waves, is considered. It is shown that if the velocity of the flow exceeds the Alfvén wave velocity in the flowing and stationary plasma system, the latter becomes unstable. In this case one of the normal waves begins to build up. (auth)

990

CONTROLLED THERMONUCLEAR REACTIONS. An Introduction to Theory and Experiment. Samuel Glasstone and Ralph H. Lovberg. Princeton, N. J., D. Van Nostrand Company, Inc., 1960. 536p. $5.60.

A survey is presented of the basic principles and the experimental approaches which are being followed in the effort to develop procedures which might be used to produce controlled energy by nuclear fusion. The physical conditions necessary for the possible methods of achieving fusion are considered, and the properties of plasmas of thermonuclear interest, the methods of producing such plasmas, and the techniques for studying their properties are discussed. The work is described that has been done on the pinch effect, the stellarator, magnetic-mirror systems, the Astron concept, and other proposed methods for plasma heating and confinement. Sources of energy loss from heated plasma are reviewed, and plasma stability theory is outlined. The book is intended for practicing engineers and scientists and advanced students of physics. (W.D.M.)

991

PLASMA PHYSICS. S. Chandrasekhar—S. K. Trehan, comp. University of Chicago Press, 1960. 227p.

Notes taken during 19 lectures given by Professor Chandrasekhar during 1957-58 at the University of Chicago are presented. The lectures covered: basic equations and conservation laws; first-order orbit theory; adiabatic invariants in the motion of charged particles; applications of first-order orbit theory; pinch stability; plasma oscillations; and transport phenomena in ionized gases. References are included at the end of each of the seven chapters. (B.O.G.)

992
HIGH ENERGY GASEOUS PLASMA CONTAINMENT DEVICE. (to United States Atomic Energy Commission). British Patent 849,208. Sept. 21, 1960.

A thermonuclear reactor is designed in which a gaseous plasma can be contained indefinitely at sufficient density to cause thermonuclear reactions; it comprises a toroidal tube made of insulating material with a plurality of magnetic coils wrapped around the tube and annular electrodes. In operation, D_2 is introduced into the tube at a pressure of 10 to 100 μ, is converted into plasma by the electric field, and is trapped in the regions where the electric and magnetic fields are at right angles. (D.L.C.)

Shielding

993 AE-24(2nd Rev.)
Aktiebolaget Atomenergi, Stockholm.
TRANSMISSION OF THERMAL NEUTRONS THROUGH BORAL. F. Åkerhielm. Aug. 1960. 20p.

Transmission measurements were performed using Maxwellian distributed neutrons from the R1 reactor perpendicularly incident upon a boral absorption plate. American, English, German, Swedish, and Swiss samples were investigated, and the results are compared to calculated values. The influence of the absorber grain size is discussed. (auth)

994 CNL-21(Rev.)
Oak Ridge National Lab., Tenn.
THE ABSORPTION AND SCATTERING OF RADIATION IN RANDOM AGGREGATES OF PEBBLES. Nicholas M. Smith, Jr. [1948]. Decl. Sept. 1, 1960. 64p. Contract W-7405-eng-26. OTS.

The attenuation of a collimated monoenergetic beam of radiation in traversing a random aggregate of pebbles is considered. It is found that there is a transmission of radiation over and above that allowed by the main density of material and that transmission is essentially exponential. This implies that a shield composed of pebbles must be increased in depth by a given ratio over that computed by means of the average density alone. A formula is given for the approximation of this ratio. The problem of computing the channelling effect reduces itself to the problem of determining the probability of penetrating an accumulated depth x' of solid material in traversing a total distance x in the pebble aggregate. The theory for this computation is developed in general for cases of continuous distribution of solid and void segments and for cases where these distributions have only discrete values. The theory for the discrete distributions is developed with the size of the discrete subunit of length as a parameter. The effect applies not only to attenuation but also to diffusion; that is, it is a purely geometrical effect. This follows from the fact that the probability of scattering or absorption is found by weighting the probable amount of solid penetrated by a negative exponential; that is, by the appropriate transport-diffusion kernel. Therefore the discussion applies not only to shielding but to all problems dealing with the transmission and diffusion of radiation through a bed of randomly oriented pebbles and is of sufficient magnitude to warrant attention whenever the pebble size is comparable to the relaxation length. Whenever the interstices between the pebbles are filled, the channelling effect still exists, but in a reduced amount. A method of estimating the effect for this case is given. (auth)

995 HW-64774
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SHIELDING PROPERTIES OF FERROPHOSPHORUS CONCRETE AS A FUNCTION OF TEMPERATURE. E. G. Peterson. July 15, 1960. 82p. Contract AT(45-1)-1350. OTS.

An investigation was conducted to determine the shielding properties of ferrophosphorus concrete at temperatures up to 320°C for neutrons and gamma radiations. Ferrophosphorus concrete was selected because of its high density and possible use in biological-shield construction. The neutron and gamma attenuation properties of ferrophosphorus concrete were determined experimentally. The thermal and resonance fluxes are based on gold-foil activation while the fast flux was determined using the $S^{32}(n,p)P^{32}$ threshold reaction. The gamma attenuation was measured with ionization chambers. The tests indicate that the ferrophosphorus concrete could be used as a biological shield. It should be pointed out that, under the conditions under which the ferrophosphorus concrete was tested, there are other concretes that could be used which would be more efficient as well as more economical. (auth)

Theoretical Physics

996 AFOSR-TN-60-1142
Weizmann Inst. of Science, Rehovoth, Israel.
COLLECTIVE MOTION IN MANY-PARTICLE SYSTEMS. Technical Note No. 4. Harry J. Lipkin. July 1, 1960. 12p. Contract AF61(052)-337.

The previous treatment of collective motion using independent particle wave functions is extended to apply to cases where there is coupling between the collective modes and the other degrees of freedom of the system. The method is shown to be equivalent to the use of redundant variables and canonical transformations, but is simpler and more easily interpreted. The wave functions are considered to be trial functions which give a good approximate description of all the degrees of freedom except the collective modes. A simple model of center of mass motion with additional coupling is used to illustrate the method. (auth)

997 IS-203
Ames Lab., Ames, Iowa.
HIGH-ENERGY POTENTIAL SCATTERING. Philip James Lynch. Sept. 1960. 157p. Contract W-7405-eng-82. OTS.

High-energy potential scattering was investigated, assuming that the scattering was mainly forward. A method devised by Tolhoek and De Groot for obtaining approximate wave functions of charged particles in constant electric or magnetic fields either parallel or perpendicular to the incident direction of motion is generalized. Approximate wave functions are obtained for both Schrodinger and Dirac particles; for a Schrodinger particle in an electric field, the procedure led to Moliere's wave function. For the case of a Schrodinger particle in a scalar potential, a relation for the exact wave function ϕ, with the approximate wave function as leading term, was obtained by applying Green's

theorem to the exact Green's function and the approximate wave function. The high-energy scattering amplitude was obtained for the cases of a spinless Schrodinger particle in a magnetic field, a Dirac particle in an electric field, and a form characteristic of a two-potential theory. A high-energy time-dependent formulation of scattering theory is set up for the Schrodinger equation by means of an approximate time-development operator Va. Approximate wave functions and approximate Green's functions for particles in electric and magnetic fields are derivable from the coordinate representation of this operator. When the potential is time-independent, integral equations for the exact time-development operator, with Va as inhomogeneous term, are shown to lead to two time-independent equations for ϕ. The partial-wave analysis is discussed, with emphasis on high-energy formulas for phase shifts corresponding to small or large angular momentums. An exact, but unwieldy integral expression for any phase shift is obtained in terms of the WKB approximation for the radial wave function. (auth)

998 AEC-tr-3865

ON THE QUANTUM-MECHANICAL MANY-BODY PROBLEM; AN EXPANSION OF THE GIBBS POTENTIAL FOR A SYSTEM OF MANY PARTICLES. Claude Bloch, Cyrano De Dominicis, and Jules Horowitz. Translated by Roger E. Mills (Los Alamos Scientific Lab.) from "Sur la Détermination de l État Fondamental d 'un Système de Particules." Nuclear Phys. 7, 451-8(1958); "Sur la Determination des Premiers États d 'un Système de Fermions dans le Cas Dégénéré." Nuclear Phys. 8, 91-105(1958); "Un Développement du Potential de Gibbs d 'un Système Quantique Composé d 'un Grand Nombre de Particules." Nuclear Phys. 7, 459-79(1958); "Un Développement du Potential de Gibbs d 'un Système Composé d 'un Grand Nombre de Particules. II." Nuclear Phys. 10, 181-96(1959); "Un Développement du Potential de Gibbs d 'un Système Quantique Composé d 'un Grand Nombre de Particules. III. La Contribution des Collisions Binaires." Nuclear Phys. 10, 509-26(1959). 146p. OTS.

In the first of these five articles, the expression for the ground state energy and wave functions for a system of many particles is derived of an expansion in contributions of terms related to linked diagrams. In the second, a limitation of the first article to nondegenerate ground states is removed for the case of a fermion system, and the special case of a nucleus with an incomplete shell is considered. The remaining three articles deal with a perturbation expansion of the Gibbs potential for a quantum-mechanical many-body system, and it is shown that several more familiar results, such as the Beth-Uhlenbeck second viral coefficient and the contributions of the Brueckner reaction matrix to the ground state expressions, may be obtained from this expansion of the Gibbs potential in the limit of zero temperature. The separate articles were previously abstracted from the original language. See Nuclear Science Abstracts, Volume 12, abstract 14376; 13, 306; 12, 14377; 13, 10293, and 13, 14705. (D.D.D.)

REACTOR TECHNOLOGY

General and Miscellaneous

999 CF-60-1-43

Oak Ridge National Lab., Tenn.

NUCLEAR CHARACTERISTICS OF BeO-MODERATED CORES VS. GRAPHITE-MODERATED CORES. R. S. Carlsmith. Jan. 15, 1960. 10p. OTS.

Multigroup calculations were performed to compare BeO-moderated cores with graphite-moderated cores, using various void fractions and core diameters. The core leakages and conversion ratios which were calculated are presented in a series of curves. (auth)

1000 CF-60-1-108

Oak Ridge National Lab., Tenn.

PROTACTINIUM LOSSES IN A BeO-MODERATED REACTOR. R. S. Carlsmith. Jan. 27, 1960. 8p. OTS.

Calculations are made of the protactinium losses in a BeO-moderated reactor due to radiative neutron capture of Pa^{233} and subsequent beta decay to U^{234}. (C.J.G.)

1001 CRL-63

Atomic Energy of Canada Ltd., Chalk River, Ont.

SIMPLIFIED DERIVATION OF THE SPHERICAL HARMONICS MOMENTS FOR CYLINDRICAL AND OTHER GEOMETRIES. A Lecture Delivered at Chalk River, June 1959. B. Davison. July 1960. 38p. (AECL-1068). AECL.

Certain points in the presentation of the spherical harmonics method in neutron transport theory are discussed. A simple derivation of the explicit expressions for the spherical harmonics moments, in the cases of cylindrical symmetry and more general geometrical arrangements, is presented. It is assumed that the cross sections are independent of energy and position, that scattering is isotropic in the laboratory coordinates, and that there are no sources inside the medium. (W.D.M.)

1002 GNEC-133

General Nuclear Engineering Corp., Dunedin, Fla.

METHOD FOR ANALYZING LOW-ENRICHMENT LIGHT-WATER CORES. SUPPLEMENTARY STUDY RELATED TO BONUS AND NUCLEAR SUPERHEAT PROGRAMS. Robert W. Deutsch. Oct. 5, 1960. 48p. Contract AT(40-1)-2674. OTS.

A three-group method is developed for analyzing light-water UO_2 cores of low enrichment. The method is composed of a series of subroutines that are consolidated to produce a set of self-consistent multigroup parameters. The thermal cross sections are determined by averaging the cross section over a "hardened" or shifted Maxwellian spectrum, the amount of hardening being a function of the macroscopic absorption-to-slowing-down ratio. The disadvantage factor is calculated using diffusion theory for the moderator and a transport condition at the surface of the rod, the accuracy of the calculation being comparable to a P_3 calculation. The epithermal capture cross section of U^{238} is based on the measurement of Hellstrand including a 1.1-barn 1/v absorption, and ignores epithermal self-shielding effects even for very close-packed lattices. The fast-fission factor is calculated relative to the experimental measurements for UO_2. The diffusion coefficients are found by averaging the measured cross sections over the appropriate neutron flux in each neutron energy group. The slowing-down cross section is defined as the diffusion coefficient divided by the neutron age, the age being determined by calculating equivalent transport and slowing-down factors relative to light-water measurements. Utilizing the two-dimensional IBM-704 PDQ digital computer code, a comparison is made with the available experimental information using oxide fuel. These experiments, which include rod-type fuel elements, use U^{235} enrichments from 1.3 to 4.0 wt. % and water-to-uranium-metal ratios from 2.2 to 4.9. The reactivity and power-distribution predictions are very good. The reactivity calculations check to within 2% Δk for all cases, most cases being with 1% Δk. (auth)

1003 MND-1707
Martin Co. Nuclear Div., Baltimore.
FUEL RECYCLING PROGRAM. Technical Memorandum No. 26. Cid Cyl-Champlin and Fred W. Todt. Mar. 17, 1959. 112p.

A fuel recycling program was written for application to the Fluidized Bed Reactor. The code was written to investigate variables such as the amount of material withdrawal from the core, the amount of uranium which must be added to maintain a specific K_{eff}, processing frequency, conversion ratio as a function of time, and time variation of fuel-region materials. The program is not restricted to fluid-bed reactors. (J.R.D.)

1004 ORNL-2967
Oak Ridge National Lab., Tenn.
EQUIPOISE—AN IBM-704 CODE FOR THE SOLUTION OF TWO-GROUP, TWO-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN CYLINDRICAL GEOMETRY. M. L. Tobias and T. B. Fowler. Nov. 2, 1960. 90p. Contract W-7405-eng-26. OTS.

An IBM-704 code for the solution of two-group two-dimensional neutron-diffusion equations in cylindrical geometry was constructed using FORTRAN. In its present form, the code can treat problems involving a maximum of 625 mesh points (including boundary points). The machine required must be at least 8K with one drum unit and seven tape units. The iterative procedure used is simpler than any currently in use. The "extrapolated Liebmann process" is used to speed convergence. Machine running times and required number of iterations have been comparable with and often less than those required by similar programs. A typical 200-point case converged in 4½ min and required 50 sweeps through the mesh. Running times are roughly proportional to the number of mesh points. No proofs are presented to guarantee that this program will converge in all cases which meet the input number requirements. However, no difficulties have yet been experienced in realistic problems, and a special example which combined an extremely bad initial flux guess with awkward material location converged in a reasonable time (23 min). (auth)

1005 ORNL-3005
Oak Ridge National Lab., Tenn.
MILNE PROBLEM WITH CAPTURE. S. N. Purohit. Oct. 14, 1960. 31p. Contract W-7405-eng-26. OTS.

The general relation between the angular flux of the neutrons in a lattice measured with a neutron chopper and the total neutron flux is discussed. A new approximate method for calculating the spatial variation of neutron flux and the emergent angular distribution of neutrons in a Milne problem with capture is formulated. This method is based upon the representation of nonasymptotic part of neutron flux by a single decaying exponential. The coefficient and exponent of this exponential were determined by the iteration method. The emergent angular distribution and total flux of neutrons in the Milne problem were calculated for a large range of absorptions and compared with the results of LeCaine, obtained by the variational method. The agreement between the two results was found to be excellent in all cases. (auth)

1006 RWD-RL-167
Ramo-Wooldridge. Div. of Thompson Ramo Wooldridge Inc., Los Angeles.
KINETIC STUDIES OF HETEROGENEOUS WATER REACTORS. Annual Summary Report—1959. Feb. 29, 1960. 218p. Contract AT(04-3)-165. OTS.

Part I, Experimental Techniques, is a description of the methods used to measure static and dynamic steam void fractions and flow rates in the laboratory. Part II, Steam Void Behavior, is a presentation of the experimental measurements of static and dynamic steam void behavior pertaining to reactor instabilities in power oscillations, including interpretation of SPERT IA oscillations based upon these measurements. Part III, Analysis of Initial Transients, presents both theoretical and experimental simulation approaches to the understanding of self-shutdown in SPERT IA power excursions. Part IV, Hydrodynamic Instability, describes some experimental observations of void and flow oscillations at constant channel power and in the absence of feedback between the void volume and power. The possible relationship of these oscillations to the power oscillations in the SPERT IA reactor is considered. (auth)

1007 TID-5646
Knolls Atomic Power Lab., Schenectady, N. Y.
A GENERALIZATION OF THE THEORY OF FLUX SYNTHESIS. Eugene L. Wachspress. Feb. 1960. 11p. OTS.

Fine detail is sometimes included in three-space-dimension diffusion calculations for the sole purpose of determining reasonably accurate region-averaged fluxes. A flux synthesis technique developed at WAPD has met with moderate success in eliminating the need for three-space-dimension calculations. A scheme for extending the applicability of flux synthesis techniques is described. (W.D.M.)

1008 TID-5647
Knolls Atomic Power Lab., Schenectady, N. Y.
REACTOR KINETICS WITH THE GROUP DIFFUSION MODEL. Eugene L. Wachspress. Feb. 1960. 21p. OTS.

Some kinetics problems require consideration of the nonseparability of space and time variation. An analysis was recently performed in an attempt to describe flux tilting such as that encountered during xenon oscillation. This analysis was restricted somewhat by the desire for application with existing reactor flux calculations. A more general analysis is presented. Application of the theory requires a complete revision of the flux-calculation techniques currently available. (W.D.M.)

1009 WAPD-BT-19
Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.
BETTIS TECHNICAL REVIEW—REACTOR TECHNOLOGY. June 1960. 97p. Contract AT-11-1-GEN-14 and appropriate NObs Contracts. OTS.

Abstracts were prepared for the 9 papers contained in this report. Papers are included on stress analyses of ω seals and ω seal welds, loop for testing relief valves, prediction of boiling vapor fractions in coolant channels, hydrogen effects on main coolant pump, hydrogen permeation through ZrO_2 films, and the measurement of sintered UO_2 compacts surface areas. (C.J.G.)

1010 WAPD-BT-19(p.59-70)
Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.
A METHOD OF PREDICTING STEADY-STATE BOILING VAPOR FRACTIONS IN REACTOR COOLANT CHANNELS. G. W. Maurer.

A three-region method of predicting steady-state boiling vapor fractions in reactor coolant channels is described. The method was compared with experimental data for an 0.087 × 1 × 27-in. channel. An agreement of ~±5% vapor fractions was found. (C.J.G.)

1011 WCAP-1419
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
MULTI-REGION REACTOR LATTICE STUDIES. Quarterly

Progress Report [for] April 1 to June 30, 1960. Ira H. Coen. July 29, 1960. 33p. Contract AT(30-1)-2176. OTS.

The Multi-Region Reactor Lattice Studies Program is an analytical and experimental program centered around a series of critical experiments to be performed at the Westinghouse Reactor Evaluation Center. These experiments will utilize stainless-steel-clad uranium dioxide fuel rods of three different enrichments and will be carried out at two moderating ratios. The experimental program objectives are (1) to provide a series of experiments which are a severe enough test of analysis so that a computational scheme which matches them will be adequate for the nuclear design of multiregion power reactor cores, (2) to develop the computational methods leading to the establishing of the increment in power output attainable in low-enrichment UO_2-fueled light-water reactors by means of a nonuniform fuel-enrichment distribution in the core, and (3) by means of improvements in the design of the control elements to minimize local peaks in core power density due to the presence of control-rod followers. An analytical program with the objective of improving methods of calculation will be carried out in conjunction with the experimental work. The results of these studies will be applied to a design study for a large power reactor using the multiregion loading concept to achieve power flattening. The significant progress and accomplishments made on each task or subtask are described. (for preceding period see WCAP-1414.) (W.D.M.)

1012 DEG-Inf. Ser.-31

THE RELATIONSHIP BETWEEN REACTOR PERIOD AND MULTIPLICATION FACTOR IN THE SUB-CRITICAL STATE. W. Baran. Translated by L. H. Sinclair (U.K.A.E.A., Risley) from Nukleonika 4, 253-64(1959). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 18322.

1013 NP-tr-482

NUMERICAL METHODS OF DESIGNING NUCLEAR REACTORS. G. I. Marchuk. p.279-317, Chap. XII of "Chislennye Metody Rascheta Yadernykh Reaktorov." Translated from a publication of the Publishing House of Atomic Energy, Moscow, 1958. 43p. OTS.

Analysis of the basic and conjugate equations of fast reactors, reduction of these equations to multigroup types, and certain methods for solving kinetic equations are discussed. (W.D.M.)

1014

INVESTIGATION OF INFINITELY LARGE, NON-MODERATED, HOMOGENEOUS CRITICAL REACTOR ASSEMBLIES. [PART] II. J. J. Schmidt (Universität, Kiel). Atomkernenergie 5, 313-23(1960) Sept. (In German)

Within the framework of the diffusion theory treatment of fast reactors, the limiting problem of neutron diffusion in infinitely expanding-unmoderated-homogeneous critical assemblies was solved. In the second part of the study, the numerical evaluation of the matrix iteration method is described, and the results obtained are tabulated. The advantages and disadvantages of the matrix iteration method in comparison with other multigroup theories are discussed. (J.S.R.)

1015

THE SPATIAL AND ENERGY DISTRIBUTIONS OF THE NEUTRONS FROM A PLANE SOURCE EMBEDDED IN AN UNBOUNDED MEDIUM. A. R. Ptitsyn. Atomnaya Energ. 9, 216-17(1960) Sept. (In Russian)

A method is offered for determining the spatial and energy distribution of neutrons from plane sources embedded in an infinite medium. The method was applied in determining the neutron density $\psi(x,u)$ in hydrogen, considering the constant ($\lambda = 1$) as the mean path. The obtained result

$\psi(x,u) = \beta_0(u)e^{-\beta_0(u)|x|} \sum_{n=0}^{3} a_n(u)\, U_n\,[\beta_0(u)/|x|]$ was correlated with C. Wick's (Phys. Rev. 75, 738(1949)) solution calculated for the energy variable $\mu = 10$. The correlated results are tabulated. (R.V.J.)

1016

CHEMONUCLEAR REACTOR. L. E. Crean, (Atomics International, Canoga Park, Calif.), L. S. Mims, and J. J. Martin. Chem. Eng. Progr. 56, No. 10, 72-6(1960) Oct.

The 1 Mw(t) chemonuclear reactor concept offers a promising device for supplying ionizing radiation to promote industrial chemical reactions. The radiation cost for the chemonuclear reactor is lower than the costs for electron accelerator machines and radiation sources reported in recent radiation application surveys. The chemonuclear reactor concept can be modified or tailored to the processing stream requirements of a number of reactions depending on the nature of the chemical reaction with regard to pressure, temperature, purification, phase, and residence time. Typical reactions for possible study are the polymerization of ethylene, the reaction of benzene and water to form phenol, and the irradiation of methanol to produce ethylene glycol. Each of these processes has a distinct set of operating variables that would require specific modifications to the reactor for a pilot-plant study of the effect of radiation on the reaction, the nature of the products formed, and the yields. The first reactor should not necessarily be expected to result in a profitable process; it should fill in many of the gaps in technological knowledge, which might be later successfully exploited in a commercial facility. (auth)

1017

A MULTIDECADE LINEAR REACTOR SIMULATOR. J. W. Schwartzenberg (Leeds and Northrup Co., Philadelphia), J. M. Finan, V. A. Underkoffler, and R. N. Brey, Jr. Commun. and Electronics No. 50, 353-8(1960) Sept.

Computer techniques utilized to accomplish a linear simulation of reactor neutron kinetics over a full operating range of 8 decades are discussed. (auth)

1018

REACTOR SIMULATORS. [PART] II. Ervin Zobor. Energia és Atomtech. 13, 372-6(1960) Aug. (In Hungarian)

The effect of reactor poisons is discussed in detail. In deriving equations for expressing poison effects, the intermediate fission products are neglected, making the simplifying assumption that I^{135} is the direct decay product of Xe^{135}. A circuit simulating the effect of xenon poisoning is given. In the same manner, the circuit reflecting the influence of the reactor on the power generating unit is also presented, emphasizing that the effect of temperature on reactivity must be negative in order to ensure a self-controlling system. The problem of computing errors in simulators is not discussed. Only electronic simulators are described, not referring to the less common electromechanical simulators. (TTT)

1019

REACTOR SIMULATORS. Ervin Zobor (Central Physics Research Inst., [Budapest]). Energia és Atomtech. 13, 478-83(1960) June. (In Hungarian)

The purpose, types, circuitry, and equations of analog computers used to simulate the dynamic and kinetic conditions of nuclear reactors are briefly reviewed. (JPRS)

1020

PNEUMATIC IRRADIATION FACILITY FOR THE MEASUREMENT OF THE THERMAL NEUTRON FLUX IN A REACTOR. P. Mulot, R. Poussot, and A. P. Schmitt (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, Suppl. to No. 7, 79A-86A(1960) July. (In French)

An apparatus for making absolute measurement of the thermal neutron flux in the core of the EL-3 reactor at Saclay by means of activation detectors is described. The apparatus consists of a pneumatic transfer system provided with solenoid valves whose sequence of operation is electronically controlled according to a predetermined program. A timing device measures the irradiation time (at the location of the measurement) and transit times (in and out of the reactor core) of the detector and its support. The system works with compressed gas (at 6 kg/cm^2 in the present case). It is capable of measuring thermal neutron fluxes up to 10^{15} $neutrons/cm^2/sec$ owing to the short transfer times achieved, and the nature of the Pb–Au alloy used as a detector. The results of measurements performed in the EL-3 reactor are given as an example. (auth)

1021

THE HETEROGENEOUS THEORY OF CYLINDRICAL NEUTRON MULTIPLYING STRUCTURES. S. E. Corno (Agip Nucleare, Milan). Nuovo cimento (10) 17, 580-98 (1960) Aug. 16. (In English)

The critical equation together with the stationary thermal neutron distribution is stated for a cylindrical neutron-multiplying structure. The fissionable material was assumed to be lumped into several blocks; allowance was made for an arbitrary distribution of them in the system. The source-sink technique was used throughout, while the neutron migration was dealt with by age-diffusion or multigroup approximations. Leakage and nonleakage probabilities as a function of the neutron birth position were carefully computed. A method was worked out for the simultaneous evaluation of the criticality, together with the maxima and minima of any function of the critical mass itself. (auth)

1022

REACTOR ANALYSIS. Robert V. Meghreblian and David K. Holmes. McGraw-Hill Series in Nuclear Engineering. New York, McGraw-Hill Book Company, Inc., 1960. 816p. $19.50.

A complete, consistent mathematical development of reactor analysis is presented. The level of the presentation is directed primarily toward the first- and second-year graduate student in engineering science, although it is expected that students in physics may find it useful. The material was developed, over a period of five years, from a course organized and presented at the Oak Ridge School of Reactor Technology (ORSORT). The subject matter is developed with the aid of various mathematical models, which have proven to be useful in describing the various neutron phenomena peculiar to reactors. Emphasis is placed upon detailed presentations of each method in order that new and different situations might be treated. (B.O.G.)

1023

IMPROVEMENTS IN AND RELATING TO HEAT TRANSFER BETWEEN A SURFACE AND A FLUID. Hugo Heinrich Ludolf Ritz and Edward Rae Elliott (to C. A. Parsons and Co., Ltd.). British Patent 847,214. Sept. 7, 1960.

A finned reactor fuel tube can be designed so that the coolant in contact with the tube surface is continually changed, thereby improving the heat transfer from tube to coolant. Three designs for accomplishing the coolant change are (1) helical fins with longitudinal baffles; (2) corrugated helical fins with longitudinal baffles; and (3) corrugated longitudinal fins. The baffles should be made of graphite. (D.L.C.)

1024

IMPROVEMENTS IN AND RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. George Harrison Inglis and Roderick Taylor (to C. A. Parsons and Co., Ltd.). British Patent 847,217. Sept. 7, 1960.

A reactor fuel tube with helical fins and longitudinal baffles is designed in which the baffles are fitted into grooves cut in each fin and held in place by support members at each tube end having projecting arms with apertures for receiving the baffle ends. Other constructional details of the tube are given, e.g., means of linking a sequence of tubes. (D.L.C.)

1025

IMPROVEMENTS IN AND RELATING TO HEAT TRANSFER SURFACES. Roger Davidson Vaughan (to C. A. Parsons and Co., Ltd.). British Patent 847,219. Sept. 7, 1960.

A reactor fuel tube with helical fins and longitudinal baffles for forming flow channels is designed so that the baffles are capable of expanding axially but not radially. This is accomplished by a ring screwed on the tips of the fins which holds the baffles in place. The ring also protects the fin edges from damage during charging or discharging operations. (D.L.C.)

1026

IMPROVEMENTS RELATING TO CONTROL EQUIPMENT FOR NUCLEAR REACTORS. Leslie Carter Ludbrook (to British Thomson-Houston Co., Ltd.). British Patent 848,521. Sept. 21, 1960.

A control system for graphite-moderated reactors is described in which the control rods are moved in groups of two or three each, each group commencing to lift when the previous group has reached either the full extent or half the extent of its travel. In this way, the reactor can be made critical as quickly as possible without loss of control. The system contains a low-frequency a-c voltage generator and separate positional motors of the synchronous type for the control rods. Complete details on the connection of the generator to the positional motors are given. (D.L.C.)

1027

IMPROVEMENTS IN AND RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Andrew Thomson Bowden (to C. A. Parsons and Co., Ltd.). British Patent 848,723. Sept. 21, 1960.

Reactor fuel elements of the solid-fuel type, housed in a container with grooves formed in the fuel and the container material made to fill these grooves in order to constrain container deformation, may be designed so that the tendency of the container material to shear off in the grooves near the element ends is greatly reduced. This reduction is effected by increasing the number of grooves near the ends, i.e., spacing them more closely as they approach the ends. (D.L.C.)

1028

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Stefan George Bauer (to United Kingdom Atomic Energy Authority). British Patent 848,901. Sept. 21, 1960.

A reactor is designed with fuel elements in the form of fissionable material dispersed in moderator material so that structural and sheath materials of large neutron-absorbing properties can be eliminated to improve reactor

efficiency. The fissionable material is usually uranium, and the moderator may be either beryllia or graphite. The fuel elements may be in the form of plates inserted in boxes fitted with grooves to provide channels for coolant flow or ribbed plates stacked one on top of another, or they may be in the form of balls which, when piled randomly, still furnish space for coolant flow. Details are given on a gas-cooled reactor with a core and reflector composed of such balls, in which the control rods are inserted into holes in the core vessel wall. The balls can be removed and replaced. (D.L.C.)

1029

NUCLEAR REACTORS. Peter Enston Rooksby and John Oliver (to Head Wrightson and Co., Ltd.). British Patent 849,001. Sept. 21, 1960.

A graphite moderator that allows for Wigner growth and prevents neutron streaming comprises hollow bricks of octagonal cross section stacked vertically with filler bricks filling the voids between the blocks and two-layer tiles separating the brick end faces. Both the bricks and tiles have male and female members on their abutting faces to interlock together, and the blocks have their minimum Wigner growth in the vertical (longitudinal) direction, while the two tile layers interposed between brick layers have their minimum Wigner growths at right angles both to that of the bricks and to each other. Since the tile layers have the longer sides of their tiles at right angles to each other, they also set up a barrier to neutron streaming. (D.L.C.)

1030

IMPROVEMENTS IN OR RELATING TO HIGH-TEMPERATURE APPARATUS. Norman Battle (to Rolls-Royce, Ltd.). British Patent 849,143. Sept. 21, 1960.

A reactor of the heavy-water-moderated, steam-cooled type is designed so that thermal stresses in the steam-handling system are relieved. The reactor comprises inner and outer tanks, the inner tank containing heavy water as moderator and the outer tank containing light water as reflector, with tubes running vertically through the tanks. The tubes in turn are divided into inner and outer portions, the inner for the fuel elements and cooling steam and the outer for a coolant, e.g., CO_2, to keep the tanks at a low temperature. To the tube ends are connected header tubes constructed with one or more bends in each to take up thermal expansion. In operation, the reactor can be controlled by varying the level of heavy water in the inner tank. (D.L.C.)

1031

IMPROVEMENTS IN AND RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Andrew Thomson Bowden (to C. A. Parsons and Co. Ltd.). British Patent 849,157. Sept. 21, 1960.

Fuel elements with helical fins and longitudinal baffles have a tendency to distort their baffles if placed into the reactor while it is still under operation, owing to the effects of the hot coolant on the edges of the baffles. This tendency can be controlled if the part of each baffle that extends beyond the fins is corrugated. (D.L.C.)

1032

A MAGAZINE FOR USE IN SUBJECTING SAMPLES TO TREATMENT IN A NUCLEAR REACTOR. Hugh Anthony Ballinger and Leonard Sidney Greenland (to United Kingdom Atomic Energy Authority). British Patent 849,178. Sept. 21, 1960.

A magazine is designed for subjecting samples to irradiation in a reactor for isotope production; it comprises a plug section to fit into a hole in the reactor biological shield, a housing projecting from the plug section into the interior of the reactor, and an external control head. The housing contains a honeycomb of individual carriers, each of which has a series of storage cells for isotope containers and an open cell to function as a transport passage. The control head can rotate the carriers individually to bring any cell in a carrier into register with cells in adjoining carriers and can load any selected cell, by means of aligned transport passages, by using a blast of gas. (D.L.C.)

1033

IMPROVEMENTS IN AND RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Hugo Heinrich Ludolf Ritz (to C. A. Parsons and Co., Ltd.). British Patent 849,216. Sept. 21, 1960.

A reactor fuel element using a beryllium container can be constructed so that a minimum amount of beryllium is used by encasing the beryllium-clad element in a graphite container. The graphite container may have helical fins and baffles extending along the longitudinal axis and has an axial length greater than that of the beryllium container so that, if the elements are stacked on top of one another, no load is borne by the fuel or the beryllium container. (D.L.C.)

1034

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Henry Reginald Clive Pratt and John Desmond Thornton (to United Kingdom Atomic Energy Authority). British Patent 849,225. Sept. 21, 1960.

Several reactor designs of the type having a coolant of liquid droplets suspended in its own saturated vapor are given in which the droplets are entrained in the vapor at the inlets of the tubes containing the fuel elements and removed from the vapor at the outlets. One design has a venturi throat and a means of liquid feed to the throat to produce the coolant. (D.L.C.)

1035

IMPROVEMENTS IN NUCLEAR REACTORS. William Robert Wootton (to Babcock and Wilcox Ltd.). British Patent 849,277. Sept. 21, 1960.

A pressurized-water reactor is designed so that loading and unloading operations are performed through a single aperture in the pressure vessel, using a pressurized auxiliary chamber containing relatively cool water as a receptacle for the elements. In order to position the elements in the core under the aperture for removal, the core is mounted on a turntable rotable on a carriage by two driving motors. In this way, the reactor need not be cooled or depressurized for loading and unloading, and its operation may be resumed quickly. Details of the reactor design are given; other details are given in patent No. 849,278. (D.L.C.)

1036

IMPROVEMENTS IN NUCLEAR REACTORS. William Robert Wootton (to Babcock and Wilcox, Ltd.). British Patent 849,278. Sept. 21, 1960.

A pressurized liquid-cooled reactor is designed so that fuel element and control rod loading and unloading can be carried out while in operation, e.g., temperature above the b.p. of the liquid and pressure above atmospheric, and is described with particular reference to the pressurized-water type. The loading and unloading operations are performed through a single aperture connected to an auxiliary pressure chamber filled with cool water and placed under the same pressure as the main pressure vessel; the elements are moved into the auxiliary chamber, and then the chamber is closed off from the vessel to permit element

removal. In order to position the elements in the core under the aperture for unloading, the core is mounted on a turntable rotable on a carriage by two driving motors. When elements are replaced in the above way, reactor operation can be resumed quickly. Further design details are given in patent No. 849,277. (D.L.C.)

1037

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Barry Edward Eltham (to United Kingdom Atomic Energy Authority). British Patent 849,308. Sept. 21, 1960.

A high-pressure CO_2-cooled heavy-water-moderated reactor is designed in which the moderator is subjected to the gas pressure at a gas/moderator interface in a pipe leading from the gas circuit to the moderator tank. Cooling coils surrounding the pipe near the interface produce an interface temperature of 5 to 15°C (gas temperature ~240°C) so that little heavy water is vaporized, and the CO_2-saturated heavy water in the pipe is slow to diffuse into the tank. In addition, a recombination unit is enclosed in the gas circuit above the interface so that radiolysis products (D_2 and O_2) can be recombined and returned to the tank. (D.L.C.)

1038

IMPROVEMENTS RELATING TO MODERATOR STRUCTURES FOR NUCLEAR REACTORS. Ronald Frederick Charles Acford (to English Electric Co., Ltd.). British Patent 849,445. Sept. 28, 1960.

A reactor moderator is designed comprising a plurality of columns of graphite blocks separated by graphite spacing tiles arranged so that the minimum Wigner-growth properties of the blocks are in the lengthwise direction and those of the tiles are in a direction normal to that of the columns. The faces of the blocks and tiles have interlocking key devices which are skewed so that axially adjacent blocks are angularly twisted relative to each other, thereby reducing neutron streaming and coolant leakage. (D.L.C.)

1039

IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. William Bateman Hall (to United Kingdom Atomic Energy Authority). British Patent 849,484. Sept. 28, 1960.

A reactor fuel plate having improved heat-transfer propties is described which has extended ribbed surfaces on at least one face in a zigzag or herringbone pattern. The plates may be spaced so that the pattern is reversed on opposed faces of adjacent plates. Typical measurements of such plates are: plate width = 4 in., plate thickness = 0.25 in., distance between plates = 0.5 in., and depth of ribs = 0.0625 in. (D.L.C.)

1040

IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Peter Fortescue and George Edward Lockett (to United Kingdom Atomic Energy Authority). British Patent 850,015. Sept. 28, 1960.

A eactor fuel element is designed comprising sleeves of fuel mixed with graphite inserted into annular recesses in a cylinder formed by a graphite tube and a graphite rod. The sleeves may contain ~1 atom in 1000 of fissionable material and may be formed by cold-compacting a mixture of powdered graphite and fissionable material in a manner described by patent No. 850,016. Since heat is transferred from the sleeves to the container by radiation, there is no need for a close fit between the sleeves and the container, and distortion of the fuel is permitted. A core built of such elements consists of seven-element clusters secured to graphite spiders in a way that a plurality of clusters may be built up in parallel. Ducts for venting the interior of the elements are provided in order to remove volatile fission products. (D.L.C.)

1041

IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Leslie Mark Wyatt (to United Kingdom Atomic Energy Authority). British Patent 850,021. Sept. 28, 1960.

A reactor fuel element of improved heat-transfer properties can be constructed using fuel rods or tubes by supporting them in a helically twisted plate, which in turn is supported inside a grooved sleeve. The rods are held in position by collars. The twisted plate adds to the required coolant pumping power, but it improves heat transfer by giving a more uniform coolant-temperature distribution and preventing coolant streaming along the rods. (D.L.C.)

Power Reactors

1042 ANL-6189

Argonne National Lab., Ill.

OPERATIONAL TESTS OF EBWR VAPOR RECOVERY SYSTEM. R. J. Gariboldi and D. R. Jacobson. Aug. 1960. 49p. Contract W-31-109-eng-38. OTS.

A description of the Experimental Boiling Water Reactor vapor-recovery system is given. The seal air operating pressures, temperatures, and moisture content were measured. Air flow through the seals was measured and seal wear was assessed. Assuming direct-cycle D_2O operation, the seals were evaluated relative to the amount of D_2O leakage that would be controlled. (C.J.G.)

1043 APAE-Memo-263

Alco Products, Inc., Schenectady, N. Y.

SM-2 TASK 3 MECHANICAL DESIGN REPORT [FOR] OCTOBER 1958 TO MARCH 1960. T. F. Connolly. Sept. 20, 1960. 79p. Contract AT(30-3)-326. OTS.

Progress on design studies under Task 3, the mechanical-design portion of the SM-2 core and vessel design, is summarized for the period Oct. 1958 to Mar. 1960. Task 3 covers the mechanical design of the reactor vessel, vessel closure, nozzle penetrations, steel reflector, core support structure, flow divider, control rods, absorbers, and fuel elements. Layouts showing the basic designs, major dimensions, and materials of construction are presented. Stresses for the reactor vessel selected were within ASME Code limits. The report does not contain final results of Task 3 work. (auth)

1044 APAE-Memo-273

Alco Products, Inc., Schenectady, N. Y.

SUMMARY OF REACTOR DESIGN INFORMATION FROM THREE YEARS' OPERATION OF A SMALL PWR. J. G. Gallagher. Sept. 9, 1960. 43p. Contract AT(30-3)-326. OTS.

Reactor design information obtained from 3 years' operation of a small pressurized-water reactor, the SM-1 (formerly APPR-1), is presented and discussed. The SM-1 reactor, designed to produce 10 Mw(t) power, employs fully enriched uranium fuel in the form of UO_2 dispersed in stainless-steel fuel plates. The reactor is cooled by water at 1200 psia and mean temperature of 440°F. Core-physics measurements were performed of temperature coefficient, pressure coefficient, rod calibration, stuck rod position, and transient xenon as a function of core burn-out. Core burn-out characteristics were compared with few-group calculations, and reasonable agreement was obtained. Thermal-heat-balance data were obtained on the reactor core. The temperature pattern in the nominal and hot

channels under operating conditions was calculated. These calculations indicated that certain of the fuel channels operated in the nucleate boiling regime. Examination of one of the fuel channels suspected of nucleate boiling indicated no adverse effects. The system response to load perturbations and during pump coast-down was measured utilizing plant instrumentation. This response was compared with analytical predictions using a lumped kinetic model, and reasonable agreement was found. Both neutron and gamma traverses were made through the primary shield during reactor operation. Gamma traverses were also made through the primary shield as a function of time after reactor shutdown. Conventional shielding calculational methods are found to give agreement with experiment sufficient for design purposes. An absolute ionization chamber was employed to measure N^{16} activity in the reactor coolant. These measurements were compared with N^{16} calculated from the (n,p) reaction on O^{16}. (auth)

1045 CF-60-9-118

Oak Ridge National Lab., Tenn.

PRELIMINARY ANALOG COMPUTER STUDY OF THE SMALL EGCR IN-PILE LOOPS. S. J. Ball and E. G. Beasley. Sept. 21, 1960. 54p. OTS.

The ORNL analog computer was used to simulate four widely different experiment conditions in the small EGCR in-pile loops. Various control and safety systems were evaluated in each case. Curves are included which show the response to postulated accidents and component failures. The results indicate that one standard control and safety system will probably be adequate for a wide variety of test conditions. (auth)

1046 DLCS-1580302

Duquesne Light Co., Shippingport, Penna.

CONTROL ROD DRIVE MECHANISMS PRECRITICAL AND INITIAL CRITICAL TESTS. CORE I, SEED 2. SECTION 3. Test Results (T-550010). First issue, Aug. 25, 1960. 6p. OTS.

Tests were conducted to assure proper operation of the control-rod mechanisms of the Shippingport Pressurized Water Reactor under normal operating conditions. (C.J.G.)

1047 DP-489

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

PRELIMINARY HAZARDS EVALUATION OF THE ISOLATED COOLANT LOOPS IN THE HWCTR. L. M. Arnett, T. F. Parkinson, D. Randall, and C. P. Ross. July 1960. 56p. Contract AT(07-2)-1. OTS.

The design features of two isolated coolant loops in the Heavy Water Components Test Reactor (HWCTR) and the effect of these features on reactor safety are described. It is shown that limitations on the operating conditions, backed up by properly chosen safety systems, will permit operation of the loops without adding appreciably to the reactor hazards. (auth)

1048 DP-515

Du Pont de Nemours (E. I.) & Co., Wilmington, Del.

HEAVY WATER MODERATED POWER REACTORS. Progress Report [for] June 1960. R. R. Hood and L. Isakoff, comps. Oct. 1960. 53p. Contract AT(07-2)-1. OTS.

At the end of June 1960, 36% of the construction and 94% of the firm design of the Heavy Water Components Test Reactor (HWCTR) were complete. Revised calculations of transients in the liquid-D_2O-cooled loop of the HWCTR showed that the safety of the loop was not impaired by recent changes in the location and design of the loop heat exchanger. Preliminary operation of a full-scale mock-up of the bayonet for the boiling-D_2O-cooled loop of the HWCTR indicated that flow-induced vibrations probably will not be a serious problem in this loop. Irradiation specimens were prepared of Zircaloy-clad tubes of uranium oxide that had been vibratory-compacted and swaged to 91% of theoretical density. The National Research University irradiation of a Zircaloy-clad uranium metal fuel tube was terminated because of mechanical damage to the assembly during an attempted reinsertion into the reactor loop. Tandem-extruded joints of Zircaloy to stainless steel were readied for long-term irradiation tests to determine the effects of exposure on the mechanical properties of the joints. (For preceding period see DP-505.) (auth)

1049 GA-1195

General Atomic Div., General Dynamics Corp., San Diego, Calif.

MARITIME GAS-COOLED REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING DECEMBER 31, 1959. 170p. Contract AT(04-3)-187. OTS.

Reactor Development: The air-flow test stand for simulating the operation of a fuel element was used for determining the friction factor and "hot channel" factor of 19 closely spaced rods. A preliminary study of the effect of reactor support mounting on the stresses and reactions of the main coolant piping was conducted to determine whether or not the reactor could be mounted on fixed supports or whether or not it must be flexibly mounted with a single degree of freedom fore and aft, and to determine the values of stresses and reactions for the fixed and flexible mountings. An analysis to determine fuel-element conditions for a range of core pressure drops for the Mark I reactor design point was completed. For a selected Mark I design, the effect of changes in the dimensions of the hot channel was calculated. A study was made of the feasibility of returning the high-temperature core outlet gas back through a vertical center duct in the core to a point below the core. The design investigation program for the control-rod drive mechanism is discussed. Fluid Systems and Plant Arrangement: The isothermal pressure-drop tests for air and helium were completed. The data, which represent ~700 individual runs, covered a range of Reynolds numbers from 25,000 to 500,000. A feasibility study was made for a system of separate reactor inlet and outlet ducts, in which the high-temperature outlet duct is cooled by an external tracer flow of helium taken from the high-pressure compressor discharge. Twenty-one conceptual designs were prepared for the main-coolant stop valve, and two valve types were selected for further engineering study. A more precise estimate was made of the maximum surface temperatures that would be reached in the reactor core as a result of a loss-of-coolant accident at full power. The computer program for the solution of the system transient equations was made operational. An evaluation study of separate- and concentric-duct arrangements for the Maritime Gas-Cooled Reactor (MGCR) plant was completed. Eight piping-arrangement cases were run on the IBM 704 computer to determine pipe stresses and reactions. Rotating Machinery: Performance characteristics of the MGCR turbines were computed in accordance with an IBM program for off-design-point conditions, and turbine maps were compiled on the basis of these results. Further study on the prototype low-pressure turbine design resulted in a reduction of the connecting shaft overhang from 48 to 24-in., with accompanying changes in critical speed. Three seal configurations were tested: the floating oil-gas seal, the Stein seal assembly, and the Stein seal with floating-ring breakdown seal. Investigations of the operation of the constant-speed turbocompressor established an allowable

speed variation of ±5%. Other studies indicated that the turbocompressor system has satisfactory steady-state characteristics over a range of sea-water temperature from 28 to 100°F and at reduced reactor power levels, reduced plant inventories, and reduced reactor outlet temperatures. A reflux heat dump was considered for removing heat from the power-turbine bypass stream. Reactor Physics: Because BeO can be produced only in small blocks (~60 $in.^3$) and because the grinding of large quantities of BeO blocks to close tolerances is prohibitively expensive, an aluminum structure was designed to support the individual moderator blocks (BeO or graphite) and fuel elements. Calculations were made on the reactivity of the BeO critical assembly under various conditions, for inclusion in the safeguards report. These calculations showed that there is not much difference in the worth of the controlling device for the BeO- and graphite-moderated cores. The temperature behavior of the proposed BeO-moderated critical facility was investigated under various transient conditions. The Adler-Nordheim-Hinman resonance integral codes were reprogrammed for the IBM 704. This was done to facilitate the large number of resonance computations required for the BeO core survey. The new program will perform the required interpolations and then will proceed to a calculation of the resonance integral and the resonance escape probability for each particular case. Calculations were made recently of the spatial variation of the neutron temperature in the core on a gross radial basis. These calculations were made using the ZOOM code. Materials Development: The primary fuel-development emphasis has been placed on the development of dispersion type metal-oxide bodies containing 20 vol. % UO_2 and having Al_2O_3 as the matrix material. Some evidence that fuel migration occurs during sintering of the Al_2O_3-UO_2 fuel bodies was observed. This evidence indicated that the fuel migration might be associated with the concentration of impurities that are present in the matrix phase, particularly sodium and potassium. Therefore an experiment was performed to determine at what level of impurity this phenomenon may become a serious problem. To obtain some indication of the effect of fuel-body composition on thermal conductivity, a preliminary experiment was performed in which the electrical resistance of UO_2-Al_2O_3 pellets was measured to assess the effect of dispersion or continuity of UO_2 when introduced as fine particles (~1 μ) or coarse aggregates (~800 μ). The general problem of fission-product release in a closed-cycle–gas-cooled system was considered. Creep-rupture tests of Inconel 713C were completed at 1300°F and 82,000 psi. Three tests were performed in helium plus 0.01 atm CO, two were performed in helium, and one was conducted in air. Work began on the correlation of Vodar's experimental results on heat conductivity of helium at high pressure. The experimental results were obtained over a temperature range of 0 to 670°F and a pressure range of 14.7 to 2500 psia. A correlation of the experimental results at atmospheric pressure was also made based on statistical mechanics methods. (For preceding period see GA-1183.) (W.D.M.)

1050 GA-1466

General Dynamics Corp. Electric Boat Div., Groton, Conn.

A LUBRICATING-OIL TEST PROGRAM FOR THE MARITIME GAS-COOLED REACTOR PROGRAM. I. Huppert and B. Weissman. Apr. 1960. 37p. Contract AT(04-3)-187. OTS.

A study of lubricants for use in helium atmospheres associated with the Maritime Gas Cooled Reactor (MGCR) is described. Lubrication requirements and the test program are outlined. The tests included vapor pressure, evaporation rate, solubility, viscosity, and foaming. The results of viscosity, solubility, and foaming tests showed no important differences, but natural-base oils are recommended because of their lower cost. The vapor-pressure and evaporation tests revealed an order of preference for the following natural-base paraffin lubricants: (1) Mobil DTE797, (2) Texaco Regal A (R and O), and (3) Esso Teresso 43. (T.R.H.)

1051 GNEC-131

Combustion Engineering, Inc., Windsor, Conn. and General Nuclear Engineering Corp., Dunedin, Fla.

NUCLEAR SUPERHEAT DEVELOPMENT PROGRAM. Third Quarterly Progress Report [for] January-March 1960. Sept. 1960. 130p. Contract AT(11-1)-795. OTS.

Research and development work aimed at establishing the technological and economic feasibility of producing superheated steam from a boiling water reactor is reported. Studies conducted during the quarter were directed toward establishing the basic configuration of the preliminary reference design. Preliminary consideration was given to a one-pass rod-annular fuel element for the maximum utilization of the "roof-top" axial power distribution inherent in a boiling water reactor. Owing to excessive centerline temperature of the rod-annular element, attention was concentrated on detailed studies of a double-annular fuel element. With a double-annular fuel element, it was possible to reduce the number of fuel elements required in the boiler-superheater region. Results of reactor physics analysis of the effects of varying the fuel enrichments in the boiler and the superheater zones are reported. Fuel element power distributions for various enrichments in the double-annular element were also determined. To distinguish between designs involving various fuel elements and core configurations, a design classification system was adopted. The critical experiment program at Windsor established preliminary reference measurements for "p", "f," and "ε." The design of the plumbing and electrical system for the remote control of the superheater section was completed. Detailed design work on the test loop to determine acceptable carry-over of moisture in steam entering superheater fuel elements was completed and sized for an earlier design of the two-pass double-annular element. Design modifications were continued on the steam separator loop. Procurement and fabrication of parts for research and development on BONUS components proceeded satisfactorily. (For preceding period see GNEC-125.) (W.D.M.)

1052 HW-48847

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

HETEROGENEOUS LATTICE FLUIDIZED BED REACTOR STUDY "RABBIT REACTOR." E. R. Astley. Mar. 5, 1957. 24p. Contract AT(45-1)-1350. OTS.

A compatible set of reactor parameters was determined by interrelated design conditions in order that a complete preliminary reactor concept could be formulated. Preliminary design estimates of reactor and auxiliary plant capital costs are presented. Variables affecting annual operating costs are listed. (W.D.M.)

1053 IDO-28555

Aerojet-General Nucleonics, San Ramon, Calif.

ARMY GAS-COOLED REACTORS SYSTEM PROGRAM. TRANSPORTABILITY STUDIES, ML-1 NUCLEAR POWER PLANT. J. W. Blakley, J. S. Alcorn, L. G. Del Valle, P. W. Healy, D. H. Moran, and W. S. Scott. Apr. 1960. 261p. Contract AT(10-1)-880. OTS.

Testing programs were undertaken to determine the transportability of the ML-1 nuclear power plant. Three transport media were investigated: tractor-trailer, aircraft, and railroad. The document includes illustrations, original data (tapes and charts made in the field by various recording instruments), and detailed illustrated appendixes. (auth)

1054 IDO-28559

Aerojet-General Nucleonics, San Ramon, Calif.

ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. Monthly Progress Report for July 1960. Aug. 31, 1960. 85p. Contract AT(10-1)-880. OTS.

Power ascension in the Gas-cooled Reactor Experiment was successfully completed to a limited power of 1.85 Mw. In development studies on the Army Reactor (ML-1), problems were encountered with porosity in the lead castings for the shield. The increase in pressure drop across the recuperator, due to the finning operation, was reduced slightly by modifying the fabrication process. The functions of the gas make-up skid and the gas storage skid are to be consolidated. All three blowers on the BMI-16 test loop, operating with a test element following removal of the I-3P, became inoperable in less than 200 hr. A peak surface temperature of 1570°F was measured for the IB-2T-1 element. Corrosion tests were performed on Hastelloy X, Inconel, and Inconel 702 at 68°F in the ML-1 reference coolant gas. The specimens were also subjected to the reference gas for 5000 hr at 1750°F. (For preceding period see IDO-28558.) (C.J.G.)

1055 M-7297

Knolls Atomic Power Lab., Schenectady, N. Y.

THREE-DIMENSIONAL FLUX AND POWER DISTRIBUTION MEASUREMENTS IN A POWER REACTOR. E. B. Fehr, J. C. Childs, and M. K. McRae. [1959]. 19p. OTS.

Three-dimensional flux and power distribution measurements in a pressurized-water power reactor present serious problems of accessibility, remote positioning, high temperature, and personnel exposure. These problems are successfully overcome by an activation-wire system which was developed and is used extensively for measurements within the core of such a reactor. Data are obtained during steady-state operation at flux levels in the range of 10^{12} to 10^{13} nv by simultaneous activation of 42 titanium-copper activation wires 0.020 in. in diameter. Pure copper wires are used for measurements in the range of 10^{9} to 10^{11} nv. A remote-drive mechanism positions the wires within 0.125-in.-diameter instrument thimbles which penetrate the reactor pressure vessel and extend vertically through the core region. Automatic counting and data processing are used to convert the measured data into the desired forms of flux and power distribution information. The individual design problems and the equipment and techniques used are discussed. (auth)

1056 MND-E-2414

Martin Co. Nuclear Div., Baltimore.

ANPP NUCLEATE BOILING PROGRAM. Quarterly Progress Report No 1. for June through August 1960. C. Eicheldinger. Sept. 1960. 37p. Contract DA-44-192-ENG-6.

Progress during the first quarter of the revised ANPP Nucleate Boiling Program is reported. A literature survey was conducted to determine the present state of the art in the transient-boiling field. Results of the survey indicate that little work of direct value to this program has been or is being performed. Specifications for the heat-transfer test section were completed. Two tubes with flow only on the inside will be used to simulate the inside and outside flow paths for a PM-1 "hot" tube. A preliminary layout of the test section is included. Some effort was spent on preliminary specifications for the transient instrumentation. Measurements of bulk coolant temperatures (inlet and outlet), test-section wall temperatures (three locations), total and differential pressures, test-section power, and coolant flow rate are planned. An analog simulation of the PM-1 core and primary loop was programmed. Flow coast-down and core voids due to boiling will be included in the simulation. (auth)

1057 NAA-SR-4604

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THE RESPONSE SURFACE OPTIMIZATION TECHNIQUE. W. D. Leggett. Sept. 1, 1960. 73p. Contract AT-11-1-GEN-8. OTS.

In two- and three-dimensional optimization studies, graphs and models can be constructed from which an optimum can be selected visually. The method of response surface optimization supplies a mathematical technique for the determination of an optimum, and consequently may be used in problems containing more than two independent variables where visual descriptions are not obtainable. Application of this method in engineering optimization studies promises advantages over standard multivariable optimization procedures, wherein only one variable is optimized at a time. An illustrative application of the response surface optimization technique is made in the design of the fuel element for a 560-Mw(th) organic-moderated reactor such that the reactor plant produces electrical power at the lowest cost. (auth)

1058 NP-9150

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

NASA RESEARCH ON THE HYDRODYNAMICS OF THE GASEOUS VORTEX REACTOR. Robert G. Ragsdale. [Nov. 1959]. 41p.

For presentation at the American Rocket Society Annual Meeting, November 16-21, 1959.

The results of a study of the hydrodynamics of a two-component gaseous-vortex system are presented. Analytical expressions for tangential velocity and static-pressure profiles in a turbulent vortex showed good agreement with experimental data. Air-flow rates from 0.075 to 0.14 lb/sec and corresponding tangential velocities from 160 to 440 fps were correlated by turbulent Reynolds numbers from 1.95 to 2.4. An analysis of an air-bromine gas mixture in a turbulent vortex indicated that a boundary value of bromine-to-air radial velocity ratio $(u_2/u_1)_0$ of 0.999 gave essentially no bromine buildup, whereas a value of 0.833 resulted in considerable separation. For a constant value of $(u_2/u_1)_0$, the bromine buildup increased as (1) the tangential velocity increased, (2) the air-to-bromine weight-flow ratio decreased, (3) the air-flow rate decreased, (4) the temperature decreased, and (5) the turbulence decreased. Analytical temperature, pressure, and tangential-velocity profiles are presented. Preliminary experimental results indicated that the flow of an air-bromine-mixture through a vortex field results in a bromine density increase to a maximum value, followed by a decrease; the air density exhibited a uniform decrease from the outer vortex radius to the exhaust-nozzle radius. (auth)

1059 NYO-2706

Sanderson and Porter, New York.

FUEL ELEMENT DEVELOPMENT PROGRAM FOR THE

PEBBLE BED REACTOR. PHASE I. Progress Report [for] May 1, 1959 to October 31, 1959. 146p. OTS.

Numerous types of high temperature ceramic fuel elements for the Pebble Bed Reactor are being evaluated. Specimens are $1\frac{1}{2}$ in. diameter uranium graphite spheres with external coatings such as silicon carbide or pyrolytically deposited high density graphite and fuel particle coatings such as alumina. Low fission product leakage rates at high temperatures have been observed for some of these coatings. High-level irradiation has given no visible evidence of radiation damage to either the silicon carbide coating or the coating-graphite bond. (auth)

1060 NYO-9059
Speer Carbon Co. Research Lab., Niagara Falls, N. Y.
THORIUM OXIDE INFILTRATION OF GRAPHITE SPHERES. W. E. Parker and F. Rusinko, Jr. June 15, 1960. 44p. For Sanderson and Porter, New York. Contract AT(30-1)-2378, Subcontract No. 4. OTS.

Work on the preparation of graphite spheres containing thorium oxide for use as breeder elements in the Pebble Bed Reactor is described. Graphite spheres of varying density were infiltrated with thorium nitrate solutions; this was followed by denitration to thorium oxide. Porosity measurements show the existence of considerable uniformity of graphite spheres within each density group with respect to apparent density, porosity, and pore size distribution. Thorium oxide loadings of 30 to 45 g in 1.25 and 1.35 g/cc apparent density spheres are possible by multiple infiltrations. Uniformity of the thorium oxide deposit becomes less as the number of infiltrations increase, but the variation is not appreciable. (auth)

1061 ORNL-1535
Oak Ridge National Lab., Tenn.
THERMODYNAMIC AND HEAT TRANSFER ANALYSIS OF THE AIRCRAFT REACTOR EXPERIMENT. Bernard Lubarsky and B. L. Greenstreet. Aug. 27, 1953. Decl. July 14, 1959. 131p. Contract W-7405-eng-26. OTS.

The Aircraft Reactor Experiment utilizes the circulating fluoride fuel as the primary reactor coolant. It is necessary, however, to employ an additional coolant whose primary function is to cool the reflector and pressure shell. Although liquid sodium will be used as the reflector coolant, the use of NaK had been assumed during the preceding year. Consequently, a considerable amount of consistent, detailed data on the performance characteristics for the reactor system using NaK as the reflector coolant has been assembled. These data are presented. A sufficient number of calculations based upon the use of sodium was made to assure that the performance with sodium will not deviate significantly from that calculated for NaK. Sodium is being used in preference to NaK because it can be more easily sealed at the pump shaft. (auth)

1062 ORNL-2999
Oak Ridge National Lab., Tenn.
THREE-MINUTE IRRADIATION AT VARIABLE POWER DENSITY OF PROTOTYPE CETR FUEL PELLETS. L. M. Ferris, J. W. Ullmann, and A. H. Kibbey. Oct. 12, 1960. 9p. Contract W-7405-eng-26. OTS.

Prototype CETR fuel pellets (95% ThO_2-UO_2, 93% of theoretical density) were irradiated 3 min in the ORR at power densities ranging from 16 to 160 Mw/metric ton thorium. No fragmentation or cracking of the pellets occurred. Variations in the irradiation conditions had no effect on the rate of dissolution of the pellets in boiling 13 M HNO_3–0.04 M NaF–0.1 M $Al(NO_3)_3$. (auth)

1063 PRDC-TR-35
Power Reactor Development Co., Detroit.
MONTHLY TECHNICAL REPORT [FOR] MAY 1960. 12p. Contract AT(11-1)-476. OTS.

Research and development activities on the Fermi Fast Breeder Reactor are briefly summarized in terms of core design, nuclear engineering, reactor vessel engineering, mechanical handling, electrical and instrumentation systems, liquid metal and steam systems, and test operations. (For preceding period see PRDC-TR-34.) (W.L.H.)

1064 PRDC-TR-36
Power Reactor Development Co., Detroit.
MONTHLY TECHNICAL REPORT [FOR] JUNE 1960. 13p. Contract AT(11-1)-476. OTS.

Research and development activities on the Fermi Fast Breeder Reactor are briefly summarized in terms of core design, materials and metallurgy, nuclear engineering, mechanical handling, electrical and instrumentation systems, liquid metal and steam systems, and test operations. (For preceding period see PRDC-TR-35.) (W.L.H.)

1065 TID-6337
General Atomic Div., General Dynamics Corp., San Diego, Calif.
HTGR STEAM GENERATOR DESIGN-1. H. N. Woebcke. Oct. 5, 1959. 23p. Project No. 32. Contract AT(04-3)-314. (GAMD-1016). OTS.

Various types of steam generators are evaluated for use in the Peach Bottom Power Reactor. A comparison is made between a steam generator employing a steam-water separator and one employing a drum type separator. Based on factors of plant cost, the number of shell penetrations, and water inventory, it is recommended that the steam generator include a steam-water separator. (C.J.G.)

1066 TID-8518(Bk. 3)
Atomic Energy Commission, Washington, D. C.
CIVILIAN POWER REACTOR PROGRAM. PART III. BOOK 3. STATUS REPORT ON AQUEOUS HOMOGENEOUS REACTORS AS OF 1959. 1960. 190p. GPO.

The status of a program to develop a thermal breeder power reactor which is based on the Th–U^{233} cycle is discussed. The general characteristics of two-region power breeder reactors which are either solution-core slurry-blanket or slurry-core slurry-blanket are described. A review of studies on corrosion, physical properties, and metallurgy of fuel materials, in particular aqueous ThO_2 suspensions, is presented. Development studies on cladding alloys are discussed. The processing of fuel and blanket materials for removal of fission and corrosion products and recovery of fissionable material is discussed. A flowsheet for the preparation of ThO_2 slurries is contained. Development studies on reactor components, systems, instrumentation, and control are reviewed. Reactor-control, safety, and criticality studies are discussed. (C.J.G.)

1067 AEC-tr-4194
France. Commissariat à l'Énergie Atomique, [Paris].
EL 4: CHOICE OF PRINCIPAL PARAMETERS. (El4: Choix des Principaux Parametres). B. Bailly du Bois and R. Naudet. Translated from Report SPM-620, Mar. 10, 1960. 25p. JCL or LC.

Considerations in the choice of principal parameters for EL-4 are discussed. The EL-4 is a heavy water-moderated, CO_2-cooled, UO_2-fueled, 100 Mw(e) reactor. The numerical values indicated have served as a reference in a number of partial studies. (W.D.M.)

1068 JPRS-2838
DEVELOPMENT OF NUCLEAR POWER ENGINEERING IN

THE USSR. V. E. (Ye.) Doroshchuk. Translated from Energetik 8, No. 2, 27-33(1960). 14p. OTS.

1069

THE ATOMIC ICE BREAKER—"LENIN." H. Daldrup (Gesellschaft für Kernenergieverwertung in Schiffbau u. Schiffahrt m.b.H., Geesthacht, Ger.). Atomwirtschaft 5, 393-5(1960) Sept. (In German)

The "Lenin," the first nuclear-powered ice breaker, whose 44,000 shaft horsepower is produced by two compact heavy-water reactors, is also the first ice breaker with turboelectric drive. It has a cruising time of 1 year. All circulatory systems are duplicated for safety reasons. The installed power is twice that which would have been possible with a conventional system for the same water displacement. The drive system, reactor and primary system, and safety considerations are described. (tr-auth)

1070

MAGNETIC AUTOMATIC POWER-RANGE CONTROL FOR AN AIRCRAFT NUCLEAR REACTOR. J. A. Russell, S. F. Hemmenway, J. L. Scharf, and P. C. Sharr (General Electric Co., Cincinnati). Commun. and Electronics No. 50, 379-84(1960) Sept.

Control system philosophy for an aircraft nuclear power plant is discussed. Advantages are asserted for a power-range magnetic control system with a minimum number of moving parts. Control system elements and computing devices are described. Performance of a "bread board" version of the control system is evaluated. (auth)

1071

WATER TREATMENT PROBLEMS IN NUCLEAR POWER PLANTS. Gergely Büki (Budapest Technical Univ.). Energia és Atomtech. 13, 220-32(1960) Apr.-May. (In Hungarian)

The water treatment problems of conventional power plants were compared with the treatment of H_2O and D_2O coolants and moderators in nuclear power plants. The radiation-induced nuclear and chemical reactions in the H_2O and D_2O were reviewed. The efficiency of the various treatment methods (coagulation and sedimentation, filtration, softening with lime and soda, evaporation, ion exchange, coagulation with phosphate, treatment with metallic powders, and clay absorption) was compared with the International Atomic Energy Agency and United States drinking water standards, and no single method alone was found to be adequate. (JPRS)

1072

TESTS ON A CAVERN FOR THE DETERMINATION OF TEMPERATURE AND PRESSURE TRANSIENTS IN A CASE SIMULATING A MAJOR LOSS-OF-COOLANT TYPE REACTOR ACCIDENT. T. Leardini, M. Cadeddu, and M. Schiavon (Società Adriatica di Elettricità, Venice). Energia nucleare (Milan) 7, 597-610(1960) Sept. (In English)

The Società Adriatica di Elettricità is now carrying out research on the containment characteristics of caverns for the underground installation of nuclear power reactors. Tests carried out on a medium-sized cavern blasted in the Dolomite mountain district of the Veneto, in Northern Italy, and located near a hydroelectric station of Società Adriatica di Elettricità are described. Such tests simulated major loss-of-coolant type reactor accidents and were included in a more complete study on the feasibility and advantages of cavern location for nuclear power plants. The results obtained from one of these tests are reported in detail. Data on the cavern, on the wall lining, and on its tightness characteristics under gas pressure are listed in another report published in Energia Nucleare 7, 517(1960). (auth)

1073

NUCLEAR ELECTRIC POWER STATIONS. S. Andrzejewski and W. Ney. Nowa Tech. No. 8, 145p.(1957). (In Polish)

Considerations are given for producing electrical power by means of nuclear reactors. Specifically discussed are electrical generating stations powered by a water-cooled uranium-graphite reactor, a pressurized-water reactor (Shippingport, Penna.), and a gas-cooled uranium-graphite reactor (Calder Hall, Gr. Brit.). Several high-power reactors acting as drivers for electric generating plants are further discussed, viz., a plant with a 1000-Mw(t) boiling heavy-water reactor (contrasted with a comparable 250-Mw(t) boiling light-water reactor) and a plant with a homogeneous aqueous reactor. The EBR-II as well as the British Dounreay installation are also considered as drivers for electric power-generation plants. (TTT)

1074

Atomic Industrial Forum, Inc., New York.
A FORUM REPORT. THE ROLE OF NUCLEAR PROPULSION IN MERCHANT SHIPPING. G. Edwin Brown, Jr. and William J. Smith, eds. Forum Report No. 31. 1960. 178p. $7.50.

On Apr. 28-30, 1960, the Atomic Industrial Forum held a conference in Philadelphia, in cooperation with the USAEC and the Maritime Administration, on the role of nuclear propulsion in merchant shipping. The program included presentations and discussions on the following topics: economic potentials for nuclear merchant ships, safety and liability problems, activities abroad, propulsion systems, and plans of shipbuilders and owners. (W.D.M.)

1075

IMPROVEMENTS IN STEAM REACTOR SYSTEM. (to Nuclear Development Corp. of America). British Patent 849,958. Sept. 28, 1960.

A power-producing system is described in which steam is generated in a reactor and used to produce power in turbines. One advantage of the system is that changes of phase take place only in the conversion elements and so steam entering the reactor may be heated to a high temperature. (D.L.C.)

1076

IMPROVEMENTS IN OR RELATING TO GAS COOLED POWER REACTORS. Peter Fortescue and George Edward Lockett (to United Kingdom Atomic Energy Authority). British Patent 850,014. Sept. 28, 1960.

A gas-cooled solid homogeneous power reactor is designed so that its stressed parts are maintained at a temperature close to that of the incoming gas; this is accomplished by making use of the radial pressure differential of the gas passing around the reflector and through the core to urge the core elements and reflector blocks together at the top. Complete details of the reactor design are given. (D.L.C.)

Research Reactors

1077 CF-53-5-225

Oak Ridge National Lab., Tenn.
THE SHIELD OF THE ORNL RESEARCH REACTOR. C. H. Barkelew. May 26, 1953. Changed from OFFICIAL USE ONLY Oct. 4, 1960. 28p. OTS.

A description is given of the components of the shield of the ORNL Research Reactor. The shield is designed so that the radiation level in the reactor building will not ex-

ceed 0.75 mr/hr of photons, 0.075 mrep of fast neutrons, or a linear combination if both are present. (C.J.G.)

1078 CF-60-8-46

Oak Ridge National Lab., Tenn.

OPERATING MANUAL FOR THE OAK RIDGE RESEARCH REACTOR. S. D. Sheppard, W. H. Tabor, B. L. Corbett, E. N. Cramer, S. S. Hurt, III, A. A. Walls, J. D. Hutchins, V. J. Kelleghan, J. F. Wett, Jr., and R. A. Costner, Jr. [1960]. 358p. OTS.

An operation manual is presented for the ORNL Research Reactor which describes all phases of startup, steady-state operation, and shutdown. Descriptions and diagrams are contained on instrumentation and control apparatus, fuels and refueling, cooling system, and research facilities. Emergency procedures and special procedures pertaining to the reactor are discussed. (C.J.G.)

1079 HW-63592

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

APDAC-I, A PCTR DATA ANALYSIS CODE FOR THE IBM 709. J. R. Lilley. Sept. 7, 1960. 40p. Contract AT(45-1)-1350. OTS.

An IBM-709 code, APDAC-1, for processing data on foil radioactivity is described. Output may consist of relative activities, saturated activities, and/or cadmium ratio and flux-spectrum data. The code is written in FORTRAN. (C.J.G.)

1080 IOP-4-B

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

NRX AND NRU REACTOR RESEARCH FACILITIES AND IRRADIATION AND EXAMINATION CHARGES. Aug. 1960. 24p. (AECL-1076). AECL.

The NRU and NRX reactors and research facilities are briefly described. Capacity and application of the various facilities are outlined. Irradiation and examination charges are listed. (W.D.M.)

1081 ORNL-3006

Oak Ridge National Lab., Tenn.

HFIR PRELIMINARY PHYSICS REPORT. R. D. Cheverton. Oct. 19, 1960. 118p. Contract W-7405-eng-26. OTS.

High Flux Isotope Reactor physics studies were conducted to establish a core design that would permit the attainment of about 5×10^{15} neutrons/cm^2-sec unperturbed thermal flux at a power level of 100 Mw. The proposed reactor is a cylindrical flux-trap reactor, having a light-water island surrounded by a fuel annulus containing fully enriched uranium, water, and aluminum. A vertical-plate control system separates the fuel region from the water-cooled beryllium side reflector. The island diameter is 14 cm; the fuel-annulus outer diameter is 38 cm; and the active core length is 45.7 cm. It is estimated that this core with enough fuel for 10 days of operation at 100 Mw will produce a maximum unperturbed thermal flux of 6.6×10^{15} neutrons/cm^2-sec and an average thermal flux of 3.7×10^{15} in a 200-g sample of Pu^{242}. The corresponding maximum heat flux was estimated to be 1.6×10^6 Btu/hr-ft^2 for a fuel element containing 0.050-in.-thick plates and 0.050-in.-thick coolant channels. (auth)

1082

NUCLEAR CALCULATION OF HIGHLY ENRICHED WATER-MODERATED REACTORS. H. Grümm and F. Putz (S. G. P. und Technische Büro der Reaktor-I. G., Vienna). Atomkernenergie 5, 309-12(1960) Sept. (In German)

The fluxes, the adjoint fluxes, and k_∞ of simple core arrangements of highly enriched swimming pool reactors are calculated according to the two-group theory. The weighting functions are discussed in detail. By a correction of D_1 the results are adjusted to the experimental values of one of the core arrangements. By means of the corrected values of D_1 further core configurations are calculated; the results are found to be in good agreement with measurements. Finally the two-group three-region code for IBM-650 developed for these calculations is described briefly. (auth)

1083

THE GAMMA-RAY SPECTRUM OF THE TVR REACTOR. N. A. Burgov, G. V. Danilyan, I. Ya. Korol'kov, and F. Shterba. Atomnaya Energ. 9, 214-15(1960) Sept. (In Russian)

A magnetic spectrometer was used for measuring the γ spectrum emitted from a heavy-water reactor radial beam hole. The geometry of the experiment is shown and the spectrum, measured with a resolving power of 1.25% for $E_\gamma > 2$ Mev, is plotted. It is assumed that lines at 4.050 and 3.987 Mev belong to U^{239}. The bond energy of the last neutron of U^{239}, determined by (d,p) reaction, is 4.63 ± 0.15 Mev, in good agreement with the γ line at 4.640 ± 0.015 Mev. Considering that U^{239} is the emitter, the absolute intensity is estimated to be of the order of 1% per capture; a considerable portion of the γ spectrum was not resolved but should be the result of neutron capture in U^{238} and U^{235} and fission. Correlations with published data show that softening of the nonresolved spectrum in passing through a graphite reflector is the result of Compton scattering. (R.V.J.)

WASTE DISPOSAL AND PROCESSING

1084 CF-60-6-93

Oak Ridge National Lab., Tenn.

MINERAL AND SEDIMENT AFFINITY FOR RADIONUCLIDES. A. Sorathesn, G. Bruscia, T. Tamura, and E. G. Struxness. July 25, 1960. 27p. OTS.

In determining radionuclide sorption by clay minerals, shortcomings in the filtration technique for solid separation and in the contact times selected for testing were noted. Filters were found to have a high affinity for cesium and strontium when these elements were present in tracer-level concentrations. Sorption equilibrium was not established in 24 hr, and the contact time was extended to 7 days. The affinity of the clay minerals illite, kaolinite, montmorillonite, and vermiculite for selected radionuclides was established after these shortcomings in the testing procedure were corrected. Illite exhibited a very high affinity for Cs^{137} (K_d = 200,000 after 7-day contact); none of the clay minerals demonstrated exceptionally high affinity for strontium (K_d = 4000 for kaolinite, which was the highest measured value). The behavior of cobalt and zirconium-niobium was complicated by the colloidal nature of the elements. The uptake of the above radionuclides by a composited sample of Clinch River sediment showed that cesium and strontium behaved in accordance with the mineralogic character of the sediment. The sediment sorbed more cobalt than was accountable by the mineral composition; organic matter interactions with the cobalt are thereby suspected. (auth)

1085 CF-60-8-72

Oak Ridge National Lab., Tenn.

ANALYSIS OF WASTE DISPOSAL PRACTICE AND CONTROL AT ORNL. Yehuda Feige, F. L. Parker, and E. G.

Struxness. Oct. 4, 1960. 50p. Contract W-7405-eng-26. OTS.

An analysis of liquid-waste-disposal methods employed at ORNL is made. High-level wastes are stored in tanks and allowed to decay; medium-level wastes are pumped to seepage pits; and low-level wastes are passed to a nearby creek with or without treatment, depending upon the level of radioactivity. Methods of monitoring and control are discussed. (C.J.G.)

1086 CRDC-855

Atomic Energy of Canada Ltd., Chalk River, Ont.

THE BEHAVIOUR OF CESIUM IN THE FIXATION OF FISSION PRODUCTS IN A GLASS. W. E. Erlebach. July 1960. 21p. (AECL-1071). AECL.

In the process of incorporating waste fission products in nepheline syenite glass, up to 60% of the cesium may be volatilized. It was shown that this loss can be reduced to a fraction of 1% by covering the mix of fission products and glass-forming material with a layer of nepheline syenite or calcium silicate 1 to 2 cm thick. The extent of the loss was shown to vary with the depth of this cover. (auth)

1087 HW-62874

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE EFFECT OF TEMPERATURE AND FLOW VELOCITY ON THE DECONTAMINATION OF REACTOR EFFLUENT WATER WITH ALUMINUM. W. B. Silker. Dec. 1, 1959. 19p. Contract AT(45-1)-1350. OTS.

The efficiency of aluminum turnings for the removal of several radioactive isotopes from reactor effluent water was studied. Evaluation was made at flow velocities ranging from 43.6 to 872 cm/min and in the temperature range 50.5 to 76.8°C. (auth)

1088 HW-63824(p.39-42)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE ORIGIN OF REACTOR EFFLUENT WATER RADIOISOTOPES. R. W. Perkins.

Previous work on the origin of reactor effluent water radioisotopes revealed that their principal source is from the activation of parent material that enters the reactors in process water and that the contribution from corrosion of the reactor process tubing and fuel-element jackets is minor. It was also observed that various amounts of these parent isotopes are incorporated in the film material that normally forms on the surfaces of the fuel elements and tubing and that they are subsequently released after spending various periods of time in this high-neutron-flux region. In order to understand and predict the behavior of these parent isotopes, it is necessary to know their physical form as they enter the reactors. To determine this, a sample of process water was filtered through a membrane filter, and the filtrate and particulate material on the filter were analyzed by activation analyses. A total of 13 radioisotopes was measured. The percentage of each radioisotope that was associated with the particulate fraction was determined. For comparison values from a previous study of the percentage of the resulting radioisotopes associated with particulate material in effluent water and Columbia River water are included. Data are tabulated and results are discussed. (auth)

1089 HW-63824(p.43-6)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE SOURCE OF FISSION-PRODUCT RADIOISOTOPES IN REACTOR EFFLUENT WATER. C. W. Thomas.

The fission products that appear in the reactor effluent water are produced from the fission of natural uranium in the coolant influent water, uranium on the aluminum fuel element jackets, or the uranium fuel within the jackets. As reactor power levels increase, the need to know the contribution from each source increases. The initial data from a study to determine this contribution showed that the fission products were released into the water immediately upon formation and illustrated that many fission-product concentrations could be calculated if the concentration of one was known. The ratios of several fission products as they appeared in the effluent water were investigated; one of these ratios was Sr^{89} to Sr^{90}. This ratio indicated the possible loss of Sr^{89} either from the holdup of strontium isotopes in the process tube for a long period of time after fission, thus differentially lowering the Sr^{89} concentration by radioactive decay, or by the direct loss within the system of some member of the 89 chain. During this phase of the study, it was discovered that at least 10 to 20% of the 89 chain was lost to the atmosphere in the form of the noble gas Kr^{89}. In addition to Kr^{89}, several other noble gases were identified, namely Ar^{41}, Xe^{137}, and Xe^{138}. No attempt was made to determine the presence of longer-lived gases such as Kr^{85}, Kr^{87}, and Kr^{88}. The main interest was not in the gases but rather in the ratio that the fission gases appeared since this would indicate the time since fission. The data to date show that there is immediate release of the fission products from the tube film into the reactor cooling water; thus it appears that the recoil of the fission fragments provide the necessary energy to either eject the fragments immediately into the water or to such a position in the film which allows rapid diffusing into the effluent stream. The initial values indicate that uranium is the major source in the water or in surface contamination of fuel-element jackets. (auth)

1090 HW-66690

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DECONTAMINATION OF IRP WITH PHOSPHORIC ACID PROCESSES. G. E. Neibaur. Sept. 2, 1960. 11p. Contract AT(45-1)-1350. OTS.

Tests of a proprietary compound of phosphoric acid for use in Hanford production reactors are described. The tests were carried out in a fission-product-contaminated loop. Coupon data are tabulated, and loop activity data are presented graphically. (J.R.D.)

1091 IDO-14526

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

IDAHO CHEMICAL PROCESSING PLANT, RADIOACTIVE WASTE DISPOSAL PROJECTS TECHNICAL PROGRESS REPORT [FOR] OCTOBER–DECEMBER 1959. J. I. Stevens, ed. Aug. 29, 1960. 27p. Contract AT(10-1)-205. OTS.

The progress of extensive laboratory and pilot-plant work on the fluidized-bed process for the conversion of radioactive liquid wastes to solids and the progress of construction of a 60-gal/hr facility are reported. Laboratory and pilot-plant studies are directed toward obtaining information on the dynamics of fluidized-bed operations, the removal of volatile fission products and solid particles from gases, and the development of equipment and operating techniques for the design and operation of the demonstrational facility which will test and further develop data and concepts on an engineering scale with high activity level wastes. Various long-term disposal aspects of radioactive waste disposal continue to be studied. Laboratory studies indicated that strontium is essentially nonvolatile at temperatures up to 1100°C. The removal efficiency of electro-

static precipitators for sub-micron alumina particles from an air stream was found to be in excess of 90% and to improve with retention time of the stream. The distribution of ruthenium between solids and off-gases of a fluidized-bed calcining process operated with recycle of liquid from a venturi scrubber was found to be approximately two parts to the solids and one part to the scrub liquid. A fluorescent method for determining particle growth in a fluidized bed is being investigated. Operating experience to date with a NaK heat-transfer system was generally satisfactory, although some mechanical problems were encountered. Equipment is being assembled for investigating the metallizing of solid particles in a fluidized bed by the metal spraying technique in an effort to determine if a high integrity coating can be applied for reduction of leaching should ground-water contact solids containing fission products. Construction of a Demonstrational Fluidized Bed Calcining Facility was ~65% complete and the completion date was estimated to be mid-June 1960. A conceptual design of a Demonstrational High-temperature Solids Storage Facility indicated the need for corrosion information on materials of construction at elevated temperatures. Short-term tests indicated Inconel and Incoloy to be the best materials for containing calcined alumina at temperatures above 1000°F, and the results of these tests are reported. (For preceding period see IDO-14514.) (auth)

1092 IDO-14530
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
IDAHO CHEMICAL PROCESSING PLANT, RADIOACTIVE WASTE DISPOSAL PROJECTS TECHNICAL PROGRESS REPORT [FOR] JANUARY–MARCH 1960. J. I. Stevens, ed. Aug. 30, 1960. 28p. Contract AT(10-1)-205. OTS.

The progress of extensive pilot-plant work on the fluidized-bed process for the conversion of radioactive liquid wastes to solids and the progress of construction of a 60-gal/hr demonstrational facility are reported. Pilot-plant studies for the reporting period were directed toward establishing operability limits for a 2-ft-square calciner and determining basic data on the dynamics of fluidized beds, such as particle attrition rates and heat-transfer rate. A short run in a 6-in.-diameter calciner using a simulated stainless-steel waste indicated no problems that could be attributed to the composition of the feed, when these results were compared with the results of calcining aluminum type wastes. Data for the leaching of cesium from calcined alumina were assembled from various sources. From these data it is shown that a dilute nitric acid leach can remove 99.99% of the cesium in less than eight theoretical stages. Also, the leaching of cesium is more difficult from alumina that was calcined at 650°C than from that calcined at 400°C. Construction of a 60-gal/hr facility for the demonstration of the fluidized-bed technique with alumina type wastes was ~88% complete and the completion date was estimated to be mid-July 1960. First, extraction-cycle waste storage tanks were sampled and then chemical and radiochemical analyses were begun. The results from one tank indicated a high degree of chemical homogeneity throughout the tank. A rate of temperature rise curve was established for one waste tank and the heat generation rate was estimated. (For preceding period see IDO-14526.) (auth)

1093 ORNL-2971(Vol.2)
Oak Ridge National Lab., Tenn.
BIBLIOGRAPHY ON NUCLEAR REACTOR FUEL REPROCESSING AND WASTE DISPOSAL. VOLUME 2. FISSION PRODUCT, POISON, AND RADIOISOTOPE REMOVAL. T. F. Connolly. Oct. 18, 1960. 156p. Contract W-7405-eng-26. OTS.

Section 2 of an eight-section bibliography on nuclear fuel reprocessing and waste disposal is presented. This section, on fission-product, poison, and radioisotope removal, is divided according to elements and methods. The headings are decimal coded for ease in cross referencing, filing, expansion, and use in an automatic microfilm viewer-printer. The complete collection includes about 7000 abstracts, nearly all from Nuclear Science Abstracts, representing books, bibliographies, symposia, journals, and contractors' topical reports. Most of the material dates from the 1955 Geneva Conference to Oct. 1960. (J.R.D.)

1094 ORNL-2994(p.1-14)
Oak Ridge National Lab., Tenn.
RADIOACTIVE WASTE DISPOSAL. LOW LEVEL WASTE WATER TREATMENT. K. E. Cowser, T. Tamura, et al.

Investigations of the distribution of radioactivity in the effluent from the process waste treatment plant showed that ~50% of the outgoing activity was associated with the suspended solids. Studies were made of the effects of several coagulant aids on the removal of these suspended solids. (auth)

1095 ORNL-2994(p.15-36)
Oak Ridge National Lab., Tenn.
DISPOSAL OF ORNL WASTES. K. E. Cowser, W. de Laguna, et al.

The study of open waste pits at ORNL was discontinued in 1959. Emphasis is now placed on studies of the disposal of intermediate-level waste in a newly designed cover pit (waste pit 5) and the development of soil-column disposal by fracturing. Burial ground 4 was closed, and 5 was opened in 1959. Although radioactivity was found in wells, seeps, and streams in and around burial ground 4, the amount of activity contributed to White Oak Creek is so small that it is difficult to measure. (auth)

1096 ORNL-2994(p.36-45)
Oak Ridge National Lab., Tenn.
EVALUATION OF CONSEQUENCES OF DISPOSAL TO ORNL ENVIRONS. E. G. Struxness, W. J. Boegly, Jr., et al.

The more hazardous fission products are adsorbed by the dominantly clay soils of the ORNL area; this provides a safety factor in the case of accidental release of radioactive cations. There are three shortcomings in the natural environment at ORNL: the high rainfall results in leaching of adsorbed activity; owing to low soil permeability, surface runoff leads to erosion and sediment transport; and the heterogeneity of ground-water movement patterns makes monitoring difficult. (auth)

1097 ORNL-2994(p.58-78)
Oak Ridge National Lab., Tenn.
SORPTION AND RETENTION BY MINERALS AND COMPOUNDS. T. Tamura, D. G. Jacobs, et al.

Cesium-sorptive capacity of several minerals was measured in simulated waste solutions and was found to vary with mineral structure, ion-exchange capacity, and saturating cation. For strontium removal from waste solution, apatite (rock phosphate) and variscite minerals were found to be potentially useful materials. (auth)

1098 ORNL-2994(p.78-95)
Oak Ridge National Lab., Tenn.
SOIL COLUMN STUDIES. D. G. Jacobs, K. E. Cowser, et al.

Several materials were investigated for sorption of

cesium and strontium from solutions similar to the ORNL intermediate-level liquid wastes. Vermiculites with added PO_4^{3-} were satisfactory for removal of cesium and strontium. Clinoptilolite and Florida pebble phosphate also appear promising for column application. (auth)

1099 ORNL-2994(p.95-128)
Oak Ridge National Lab., Tenn.
DISPOSAL IN SALT FORMATIONS. E. G. Struxness, F. L. Parker, et al.

Theoretical studies and both field and laboratory experiments are under way to define and solve the problems involved in the storage of liquid and solid wastes in natural salt deposits. Temperatures obtained in the field experiments are in agreement with theoretical calculations. Radiolytic gas production is a more serious problem than chemical gas production with Purex type wastes. (auth)

1100 ORNL-2994(p.128-36)
Oak Ridge National Lab., Tenn.
DISPOSAL OF RADIOACTIVE WASTE BY HYDRAULIC FRACTURING. W. de Laguna and B. L. Houser.

Tests are under way to determine the feasibility of injecting large volumes of radioactive waste into rock formations by hydraulic fracturing. A preliminary experiment, in which 26,000 gal of Cs^{137}-tagged cement was injected at a depth of 290 ft, resulted in the production of a nearly horizontal thin sheet of grout. (auth)

1101 WIN-117
National Lead Co. Inc. Winchester Lab., Winchester, Mass.
WINCHESTER LABORATORY QUARTERLY REPORT, APRIL 1, 1960–JUNE 30, 1960. A. C. Herrington and A. S. Goldin, comps. and eds. Aug. 26, 1960. 35p. Contract AT(49-6)-924. OTS.

This report, covering the operations of the Winchester Laboratory for the second quarter of the year 1960, summarizes work done in analytical development, decontamination of uranium mill effluents, and evaluation of radiological hazards related to milling operations. A procedure for the direct determination of isotopic radium concentrations at low levels is presented and evaluated, and published methods for total radium are discussed. A technique for decontamination of mill effluents by barium chloride addition is described, and some data are presented on barite treatment. Preliminary work on the biological hazards of uranium mill dusts is reported, as well as a program of study of the erosion of mill tailings. (For preceding period see WIN-116.) (auth)

1102
USE OF FLOTATION IN TREATING RADIOACTIVE EFFLUENTS. S. A. Voznesenskiĭ, G. A. Sereda, L. I. Baskov, E. V. Tkachenko, and V. F. Bagretsov. Atomnaya Energ. 9, 208-13(1960) Sept. (In Russian)

Effluent water decontamination by flotation was studied using iron hydroxide with sorbed radioactive isotopes. It was observed that radioactive isotopes are not desorbed during flotation. Studies were made of the floatability of iron hydroxide with respect to solution alkalinity, concentration of reacting substances, and the presence of various admixtures. Chemical reactions of iron hydroxide with the flotation reagent are analyzed. Data are also given on flotation of the iron hydroxide precipitant formed. (tr-auth)

1103
PROBLEMS PRESENTED BY LIQUID WASTES FROM NUCLEAR PLANTS. E. Cerrai (Centro Informazioni Studi Esperienze, Milan). Energia nucleare (Milan) 7, 581-9 (1960) Sept. (In Italian)

A survey is given of the papers presented at the Symposium on the Engineering Aspects of Industrial Water, held in Milan. Some experiments on procedures for the decontamination of radioactive raffinates and methods for the measurement and detection of radioactivity are described. (J.S.R.)

1104
THE TREATMENT OF LIQUID RADIOACTIVE WASTES IN THE CISE RADIOCHEMISTRY LABORATORY. E. Cerrai, A. Scaroni, and C. Triulzi (Centro Informazioni Studi Esperienze, Milan). Energia nucleare (Milan) 7, 630-7(1960) Sept. (In Italian)

The procedure for the treatment of radioactive wastes in the CISE Radiochemistry Laboratory is described in detail. The liquids are decontaminated by flocculation with ferrophosphate, fixed on silver bentonites, and purified with ion exchange resins. The decontamination values for various types of wastes are tabulated. The laboratory apparatus used for the decontamination is described. (J.S.R.)

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